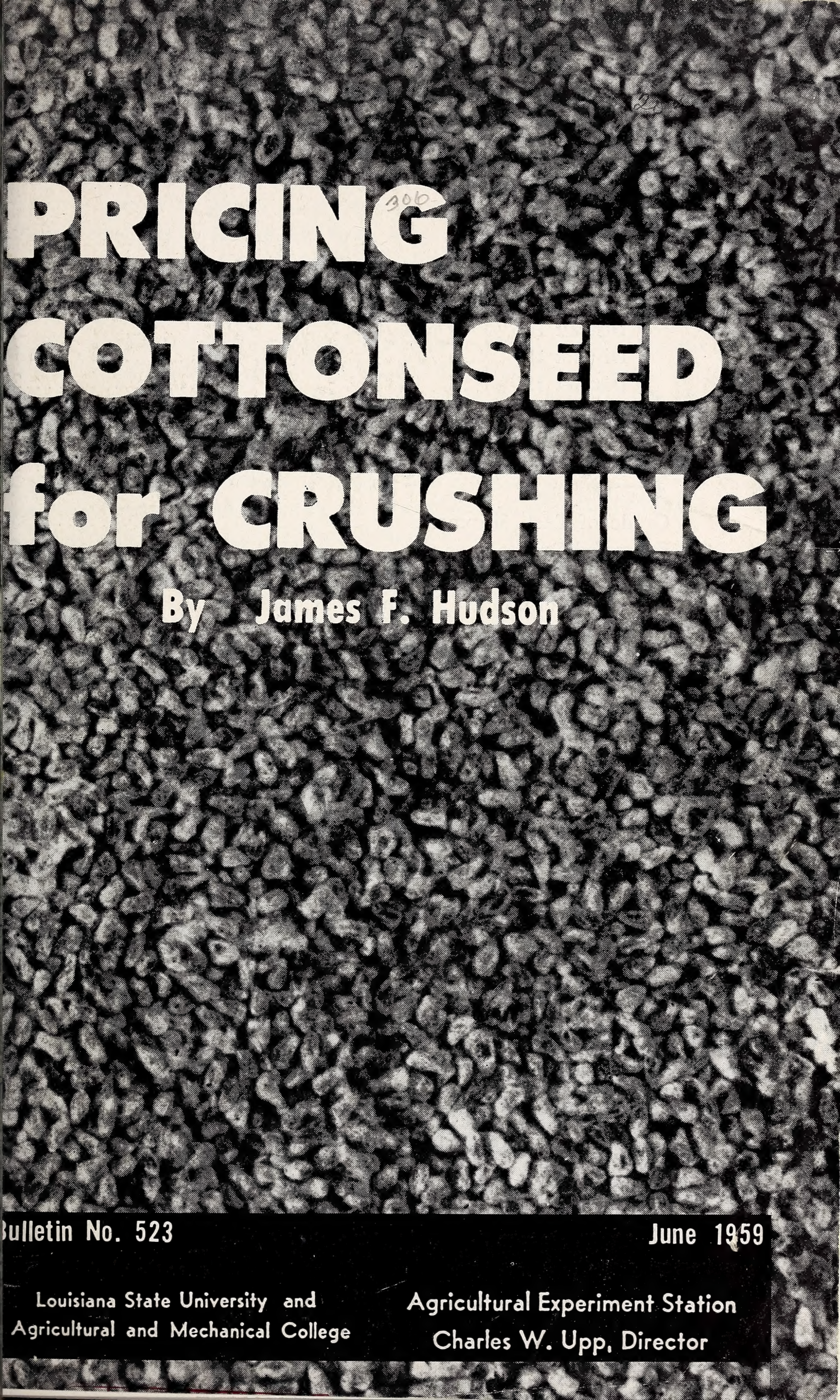
Digitized by the Internet Archive
in 2015

https://archive.org/details/louisianabulleti5235loui



PRICING COTTONSEED for CRUSHING

306

By James F. Hudson

ulletin No. 523

June 1959

Louisiana State University and
Agricultural and Mechanical College

Agricultural Experiment Station
Charles W. Upp, Director

TABLE OF CONTENTS

Summary and Conclusions 3
Introduction 9
  Statement of Problem 10
  Scope and Objectives 11
  Research Procedure 11
Accuracy of Present Method of Pricing Cottonseed 13
  Analysis of Pricing Errors 13
    District I 15
    District II 18
    District III 20
    Combined Analysis 21
    Pooled Regressions 29
Alternative Pricing Systems 30
  Actual Grades 30
  Grade of Each Shipment 30
  Estimated Grades 31
Alternative Methods of Estimating Cottonseed Grades 31
  Regression of Grade and Moisture Content 32
    Estimation Equations 35
    Errors in Estimating Grade 36
  Regression of Grade and Oil Content 42
    Estimation Equations 43
    Errors in Estimating Grade 43
  Multiple Regression of Grade, Oil Content and Moisture Content 46
    Estimation Equations 49
    Errors in Estimating Grade 49
Prices Predicted on the Basis of Estimated Grades 53
  Price Prediction Equations 54
  Accuracy of Predicted Prices 55
    Moisture-Grade Predicted Prices 55
    Oil-Grade Predicted Prices 61
    Oil-Moisture-Grade Predicted Prices 67
Appraisal of Pricing Accuracy of Suggested Alternative Pricing Systems 69
  Limitations of the Study 74

SUMMARY AND CONCLUSIONS

Cottonseed is marketed almost entirely through a simple distributive process of grower to ginner to oil mill. Sales by the ginner to the oil mill are generally made on the basis of an official grade analysis of the seed. No economical method is available to grade the small lots of seed as sold by the producer to the ginner. Purchases by the ginner from producers are made on a flat price per ton basis. No differentials are paid by the ginner for different qualities of seed purchased at any one time. This is a basic problem in the marketing of cottonseed.

The primary objectives of this research were: (1) to evaluate the pricing accuracy of the present method of marketing cottonseed; (2) to suggest alternative methods of pricing cottonseed at the gin, and (3) to evaluate the pricing accuracy of these alternatives. The relationships between oil content and moisture content of cottonseed and cottonseed grades were explored as a basis for alternative methods of pricing.

The study was based on data collected from a 10 percent random sample of cotton gins in three of the four cotton areas of Louisiana. Data were obtained from 21 gins in 1956 and 20 gins in 1957. Data on 1,102 lots of cottonseed, representing 86,800 individual bale lot purchases by ginners from producers, were included in the analysis. Information on the amount purchased, price paid per ton by the ginnner to the producer, amount sold, grade, grade analysis, oil mill base price per ton, and price received per ton by the ginner from the oil mill was obtained for each lot of cottonseed.

The price per ton received by the ginners from the oil mills was used as the criterion of pricing accuracy in the analysis of the present and alternative methods of pricing. The grade of each lot as shown on the official grade analysis was used as a criterion for the analysis of grading accuracy of the alternative methods of estimating grade. The prices paid per ton by ginners were adjusted by the addition of a $5.00 per ton margin. The difference between the price received by the ginner from the oil mill and the adjusted price paid by the ginner for each lot of cottonseed was used as a measure of pricing error. Errors in estimated grades were analyzed in a similar manner. As an additional measure of pricing error, a computed regression of price paid on price received was compared with a theoretical unbiased regression. The difference between the two regression lines was used as a measure of the average pricing error.

The first phase of the study was concerned with an analysis of the pricing accuracy of the present system. Pricing errors were analyzed by districts, by years and for all districts and years combined. Grading accuracy was analyzed for each of three alternative methods of estimating grade: (1) grade estimates based on moisture content alone, (2) grade estimates based on oil content alone and (3) grade estimates based on both oil and moisture contents. Because of the influence of free fatty acid content on grade, the data were subdivided into three groups for the grade analysis: (1) seed containing 2 percent or less free fatty acid, (2) seed containing 2.1 to 4.9 percent free fatty acid and (3) seed containing 5 percent or more free fatty acid. The third phase of the study was concerned with an analysis of the accuracy of alternative pricing systems based on the three methods of estimating grade.

Linear regression analysis revealed a positive, significant relationship between the prices paid by ginners for cottonseed at the gin and the prices received by ginners for the seed from the oil mill in both seasons and all districts, except District II during 1957. However, all of the regression coefficients were significantly different from 1.0, indicating pricing errors.

The pricing errors were smaller in 1956 than in 1957 in all districts and were smaller in District I than in the other two districts. Prices paid by ginners were biased upward in 1957 and biased downward during 1956. On the average, in all districts during both seasons, prices paid by the ginners underestimated the prices received from the oil mills for values greater than the mean and overestimated those less than the mean. A similar relationship existed for all districts and seasons combined.

The analysis indicated that the present system on the average overpaid producers for cottonseed with the least desirable qualities, and underpaid them for cottonseed with the most desirable qualities. In addition, under the present flat price system individual bale lots of high quality seed did not command a price differential over less valuable lots of seed. Producers of cottonseed were not given any incentive to improve the quality of their product. The price system did not reflect consumers' desires accurately to producers. This would tend to lead producers to misallocate productive resources among the different grades of cottonseed. They would tend to produce more than consumers want of the lower quality seed and less of the more desirable, high quality cottonseed.

Under the present system neither consumer satisfaction nor producer returns are maximized. The use of high quality cottonseed results in higher quality cottonseed products as well as in lower processing costs. Therefore, the failure of the pricing system to pass on to the grower the price differentials which reflect differences in the milling value of cottonseed to oil mills adversely affects the consumers of cottonseed products as well as the producers who produce high quality cottonseed.

The six factors affecting cottonseed grade, in the order of their importance, are the free fatty acid content of the oil in the seed, the oil, moisture, ammonia and foreign matter contents of the seed, and a linters factor. The United States Department of Agriculture has been working to develop an economical method of grade analysis to determine these factors at the gin. Up to the present time satisfactory methods of analysis have been developed to determine only the oil and moisture contents of cottonseed.

Since practical methods have been developed for the determination of the oil and moisture content of cottonseed at the gin, use of these factors was considered as possible means of estimating cottonseed grades. Single variable and multiple regression analysis was used to develop grade estimation equations based on these factors. A highly significant relationship was found between the moisture content of cottonseed and grade, as determined by the official grade analysis, in each of the free fatty acid groups, except the 5 percent or more group. The relationships between the oil content and grade and between the oil and moisture contents and grade were found to be highly significant in all three acid groups. The relationships were found to be considerably higher in the 2 percent or less acid group for each of the grade factors and for the two factors combined. The results indicated that the selected factors could be used either alone or in combination to estimate cottonseed grades.

The least squares estimation equations developed in the grade analyses were used to estimate the grade of each lot of seed. Grading errors were analyzed in the same manner as pricing errors. Grading errors increased with the free fatty acid content for all three methods. On the average, within each acid group, grade estimates for grades above the mean underestimated the actual grade while those below the mean overestimated the actual grade. This type error was smallest for the 2 percent or less acid groups. The moisture estimated grades were the least accurate, while the oil-moisture estimated grades were the most accurate means of estimating grade. Since no data were available on the grades as estimated by ginners, no comparisons could be made on this basis.

The theoretical grade standards developed in the grade analysis section were used as a basis for predicting prices for the analysis of pricing accuracy of the alternative methods. The predicted price of each lot was obtained by multiplying the grade estimate of the lot by the oil mill base price for that lot. Pricing errors increased with the free fatty acid content of the seed for all three methods. The extent of the error for high acid seed was considerably larger for the moisture-grade predicted prices. The predicted prices of all three methods overestimated the value of seed less than the mean and underestimated that above the mean. This type error was larger for the high acid content groups. For each of the alternative methods this type error was considerably smaller than that found in the present system. For each alternative method the plotted dots were arranged more closely around the unbiased regression line than was true for the present system.

The correlation coefficient, regression coefficient, variance of estimate and standard error of estimate are measures of pricing accuracy. The larger the correlation and regression coefficient and the smaller the other measures, the more accurate the pricing method. The present method of pricing cottonseed was found to be less accurate than any one of the alternative methods in terms of these measurements.

The variability of predicted prices about the computed regression line was exceedingly small for the 2 percent or less free fatty acid group, indicating a high degree of accuracy in these prices. The coefficients of determination were also much higher for this group. This indicated that a substantial reduction in pricing errors may be obtained through the use of the alternative pricing methods during seasons in which the free fatty acid content of seed is low.

A higher degree of pricing accuracy was obtained through the use of the oil-moisture-grade method. It was noted, however, that the differences in accuracy were quie small between this method and the oil-grade method. Decisions as to which method to use would depend upon the relative cost of grading for each method and other operational efficiency aspects.

Although it was not possible to measure the extent of the pricing error for individual bale lot purchases by the ginners from producers, it was concluded, on the basis of the findings in the study, that the alternative methods would result in a substantial increase in the accuracy of pricing individual lots. Each of the alternative methods may be used for the purchase of individual bale lots of seed on the basis of their estimated quality. This is not possible under the present flat price system.

The reduction in pricing errors obtained by the use of any one of the three methods was considered substantial enough to warrant their consideration as practical alternatives to the present sytem of pricing cottonseed at the gin. On the basis of pricing accuracy alone, use of the oil-moisture-grade standard in conjunction with the oil mill base price offers the greatest possibility for improvement in the marketing of cottonseed.

If at some future date, a rapid and inexpensive method of free fatty acid content determination is developed, its use along with moisture and oil content would provide an even more accurate basis for grading seed at the gin and would make further reductions in pricing errors possible.

Use of the alternative pricing methods discussed would enable the ginner to purchase individual lots of seed on the basis of quality differences. This would mean that the money paid for cottonseed would be distributed more equitably among the different producers. Each producer would get more nearly what his particular cottonseed is worth. Producers of high quality seed would obtain a higher price while producers of low quality seed would obtain a lower price for their seed. This would give producers an incentive to produce higher quality seed. The alternative pricing methods would more accurately reflect consumers' desires to producers. This would tend to lead producers to allocate productive resources more equitably among the different grades of cottonseed. Producers would have an incentive to produce more of the desirable high quality seed and less of the low quality seed. As the quality of the crop increased, the total income from the crop would be greater. The costs of handling and processing low quality seed are also greater than for high quality seed. Any improvements in the quality of the crop would be reflected in lower overall operating costs for the industry. The alternative pricing systems would result in both greater consumer satisfaction and higher producer returns than the present system offers.

The primary advantage to be gained by the ginner in using the alternative methods is the reduction of risk in handling seed. Use of the alternative methods would enable the ginner to more accurately predict the price he will receive for the cottonseed from the oil mill. Any such reduction in risk should be welcomed by the ginner. In addition, there are possible cost reductions for handling higher quality seed. Any advantages of this nature, however, would be offset to the extent of the increased costs in performing the grading of individual bale lots of seed. If the reductions in risk and cost more than offset the cost of grading, then eventual reductions in margins may be possible.

In view of these findings, the theoretical grade standards set forth in this study are offered as a tentative method of reflecting quality differentials to producers that may be used until an economical method of complete grade analysis of individual bale lots of cottonseed is developed.

It is recommended that: (1) the proposed grade standards be thoroughly field tested, and (2) the operational efficiency aspects be thoroughly analyzed before recommending the adoption of any one of the alternative methods for actual use.

Pricing Cottonseed For Crushing

JAMES F. HUDSON
AGRICULTURAL ECONOMICS DEPARTMENT

INTRODUCTION

Cottonseed is a joint product in the production of lint cotton. In the early days of cotton production, cottonseed, other than for planting purpose, was looked upon largely as a waste. However, the discovery of many new uses for crude cottonseed products has resulted in a rapid growth of the cottonseed processing industry. The value of cottonseed in the United States has increased to such an extent that it now represents 12-19 percent of the total value of the cotton crop.[1] Income from the sale of cottonseed in Louisiana amounted to $11,542,000 in 1956 and $6,678,000 in 1957.[2] The reduced value in 1957 was due to a short crop and lower average seed quality.

Cottonseed crushing mills turn out four products: crude cottonseed oil, cottonseed meal, cottonseed hulls and cotton linters. Each of these products competes with substitute products on the market.

The consumer demand for cottonseed products is reflected by the oil mill base price for "basis grade" seed (grade 100). The quantity of products produced and the proportions of the various products milled from a ton of cottonseed are determined largely by the quality of the seed. A larger proportion of the more valuable products can be milled, and a smaller manufacturing loss sustained from high quality cottonseed. These quality differences are reflected in the prices paid by the oil mill in the form of premiums and discounts for seed grading above or below the "basis grade."

In buying cottonseed from ginners, the oil mill offers a price for "basis grade" seed (grade 100). A sample of the seed to be purchased is chemically analyzed by a chemist licensed by the United States Department of Agriculture. If the seed grade is above 100, the ginner receives a premium above the base price. A discount is applied if the seed grade is below 100.

---

[1] U. S. Department of Agriculture, Agricultural Marketing Service. Statistics on Cotton and Related Data 1920-1956. Revised. U. S. Department of Agriculture, Stat. Bulletin 99. 1957. Calculations based on table 206, p. 215.

[2] U. S. Department of Agriculture, Agricultural Marketing Service. Fats and Oils Situation. FOS-186. p. 28. FOS-192. p. 18.

The grade analysis is based on a random sample of seed drawn from each shipment to the oil mill. Each sample represents approximately 30 tons of seed. The ginner purchases cottonseed from producers on an individual bale lot basis, consisting of approximately 800 to 850 pounds. Each sale by the ginner, therefore, represents 70 to 75 individual bale lots of cottonseed.

Ginners sell their seed to the oil mill on the basis of an official grade analysis, but at present no economical method has been developed for grading the small lots of cottonseed purchased by the ginner from the producer. The ginner purchases seed from the producer on the basis of a flat price per ton posted at the gin. The producer doesn't normally bargain with the ginner over the price paid for cottonseed. If he is not satisfied with the price or can obtain a higher price elsewhere, he refuses to patronize the gin. Competition among gins for customers within an area tends to equalize prices paid for seed at any one time. Whitten[3] reported that the prices posted by ginners relate indirectly to prices received for seed from the oil mill, but such prices apply to the estimated quality of seed currently being received at the gin. Ginners normally calculate prices by subtracting a margin from the current mill base price to defray marketing costs and allow a profit. They make a further price adjustment to compensate for any difference between the estimated quality of seed arriving at the gin and that of the "basis grade" seed. All lots of cottonseed are purchased for the same price, at any given time, and cottonseed producing high value products does not command a differential over less valuable seed. Individual producers of seed are not given a price incentive to improve the quality of the product they bring to the gin.

Statement of Problem

That part of the work of plant breeders and agronomists which leads to improvement in the quality of cottonseed for crushing purposes will have little practical significance unless and until consumer preference, as reflected in premiums and discounts above and below the oil mill base price, is reflected in a differential price paid by ginners to producers. In addition, there will be little incentive for producers to extend any effort toward quality improvement in the form of better cultural, harvesting and handling practices.

The desirability of having a pricing system that would pay individual farmers more in line with what their product is worth to the processor is apparent. From the ginners' standpoint such a pricing system might also be advantageous. Although this may not necessarily mean that a higher price would be paid for cottonseed by all ginners, it would effect a more equitable distribution of the money paid out.

---

[3] Whitten, Marion E., and Stevenson, Joseph H. Marketing of Cottonseed. U. S. Department of Agriculture, Production and Marketing Administration, Cotton Branch. 1949. p. 4. (Mimeograph)

Scope and Objectives

This study is concerned with the shortcomings of the present pricing system for cottonseed at the ginner market and the possibility of developing alternative methods of pricing seed which may more nearly approach an optimum price system. The specific objectives of the study are as follows: 1. To evaluate the present method of pricing cottonseed at the gin in terms of its accuracy in reflecting premiums and discounts for grades above and below the basis grade and changes in the oil mill base price. 2. To examine the economic significance of pricing errors in the present system. 3. To suggest alternative methods of pricing cottonseed at the gin and test the pricing accuracy of these methods.

The study is limited to an analysis of cottonseed prices at selected gins in three of the four cotton areas in Louisiana. No attempt is made to make a comparative analysis of prices in these areas with those in any other area or state. Although the study is limited to Louisiana, it is felt that the findings are applicable to other areas where similar conditions exist.

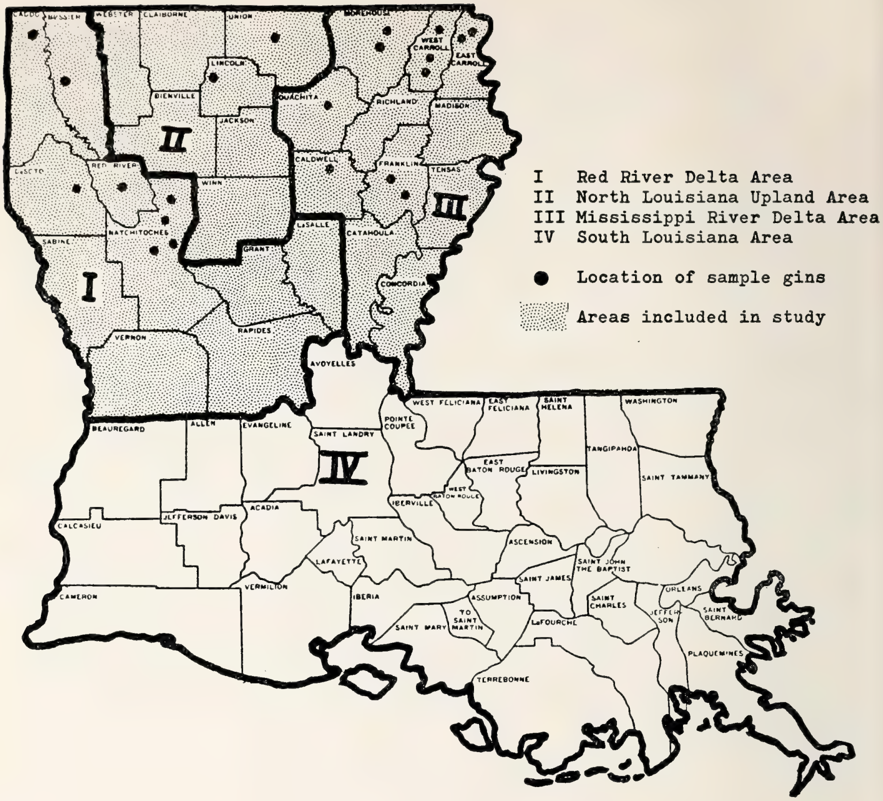
Research Procedure

The primary data for the study were collected from a 10 percent sample of cotton ginners located in three of the four cotton quality reporting districts in Louisiana (Map 1).

Twenty-one gins were included in the sample for 1956 and 20 gins in the 1957 sample. Data were obtained on 574 sales by ginners during 1956 and 528 in 1957. These sales represented approximately 86,800 individual bale lots of cottonseed.

Data on purchases from producers and prices paid by ginners for cottonseed were obtained directly from gin ticket books. Sales of seed to oil mills, oil mill base prices, and prices received from the oil mill by ginners were obtained directly from the gin sales invoices. Data relative to the grade and analysis of seed were obtained from the official grade analysis sheets. Additional information on buying and selling practices was obtained by personal interview with the owners of the gins.

Supplementary data on the average grade and analysis of cottonseed in Louisiana were compiled from annual cottonseed quality reports issued by the United States Department of Agriculture.



Map 1.—Location of sample gins by cotton grade and staple reporting districts, Louisiana, 1956-57.

Before an analysis could be made, it was necessary to relate the individual bale lots of seed purchased by the ginner from the producer to the appropriate shipment to the oil mill. Ginners reported that seed were shipped as fast as they accumulated a truck load. In addition, the type of seed house commonly used to hold seed is built so that seed are fed in at the top and taken out at the bottom. In view of these facts, it was logical to assume that the first seed purchased were the first seed sold.

Another factor of concern in relating seed sales and purchases was the difference in weights indicated on the gin ticket books and those on the oil mill invoice. The gin purchases were based on the weights as determined at the gin; the oil mill sales were based upon the weights as determined by the oil mill. The oil mill weights may be more or less than the gin weights, depending upon the accuracy of the gin weights and the amount of handling and shipping losses incurred. This difficulty was overcome by determining the total difference in weight for the entire season, converting it into a percentage-gain-or-loss factor and using this factor to adjust the weight of each individual shipment of seed. Using the adjusted weights, the individual bale lot purchases were accumulated into lots equaling the shipment to the oil mill.

If the gin price changed before a shipment was accumulated, this shipment was split on the basis of the amount of seed purchased at each price. In this manner all of the seed purchased was identified with the shipment to the oil mill in which it was included and the price paid for each lot was identified with the price received for the lot. The grade analysis for each lot was established in the same manner.

ACCURACY OF PRESENT METHOD OF PRICING COTTONSEED

The prices ginners pay producers for cottonseed represent the ginners' estimates of the prices they will receive from the oil mill less a margin for handling. An analysis of the prices paid[4] and received by ginners for cottonseed should yield information relative to the accuracy of the present pricing system. The approach used in this analysis is an adaptation of methods developed by E. H. Jebe and Elliott S. Clifton[5] for the study of yield and grade estimates of livestock. A somewhat similar technique was used earlier by Dowell and others.[6]

Analysis of Pricing Errors

The first step of the analysis consisted of a comparison of the average prices paid by ginners for cottonseed with the average prices received from the oil mill. The (t) values for the differences between the means were calculated to test the hypothesis that the groups had the same mean.[7] Small non-significant differences indicated that there was no bias on the average in prices paid by ginners for cottonseed. Significant negative differences indicated a downward bias on the average in prices paid, or under-pricing, while a positive difference indicated an upward bias, or over-pricing.

---

[4] "Prices paid" refers to prices per ton paid for cottonseed by the ginner to cotton producers at the gin. "Prices received" refers to the prices per ton received by the ginner for the seed when sold to the oil mill.

[5] Jebe, E. H., and Clifton, E. S. Estimating Yields and Grade of Slaughter Steers and Heifers. Journal of Farm Economics. Volume 38: 584-596. 1956.

[6] Dowell, A. A., Engelman, Gerald, Ferrin, E. F., and Anderson, Phillip A. Marketing Slaughter Cattle by Carcass Weight and Grade. Minnesota Agr. Expt. Sta. Tech. Bulletin 181. 1948.

[7] Snedecor, George W. Statistical Methods. Fourth Edition. Ames, Iowa, Iowa State College Press. 1946. For discussion of group comparisons see pp. 75-78.

Even if there was no bias on the average for all prices paid, the ginner might have overpriced some purchases and underpriced others. If there was a price bias, it might have been more for some purchases than for others.

The second step of the analyisis was concerned with determining if such a condition was present. This consisted of computing a linear regression of prices paid on prices received by ginners for cottonseed and comparing the estimated regression coefficient with the regression coefficient of an unbiased regression line.[8] If the prices paid and received were the same, the computed regression coefficient would equal that of an unbiased regression line (1.0). If the computed regression coefficient differed significantly from 1.0, pricing errors were indicated. Graphic analysis of the two regression lines indicated the extent and direction of the pricing error. The computed regression line represents the average relationship between the two variables. When viewed graphically, the vertical distance between the computed and unbiased regression lines indicates the average pricing error involved. This error varies for different points on the computed regression line, depending upon its slope in relation to the unbiased line.

In the graphic illustration of the relationship between the two variables, each dot represents one or more lots of cottonseed.[9] Where the pricing system is not completely accurate, the dots lie either above or below the unbiased line. Dots above the line represent lots for which price paid exceeded price received—lots which are overpriced. Dots below the line represent lots for which price received exceeded the price paid—lots which are underpriced. The vertical distance between a dot and the unbiased regression line indicates the extent to which price paid departed from the price received for each lot—the farther the distance, the greater the difference between the prices and the greater the pricing error.

Other statistics computed in the analysis were the coefficient of determination, standard error of the estimate, standard error of the regression coefficients, standard deviation of the means, and the standard error of the mean differences.

---

[8] It was decided to compute the regression of prices paid on prices received in view of the fact that prices paid are in effect estimates of prices received and therefore dependent upon them. Both variables are subject to error, but error may be expected to be smaller for prices received in view of the system of flat prices paid by ginners.

[9] In plotting the data, it was noted that several of the observations fell on the same point. The scatter of dots may be misleading if this fact is not kept in mind. It would be especially misleading in an attempt to locate the means in reference to the scatter of dots and the slope of computed regression lines.

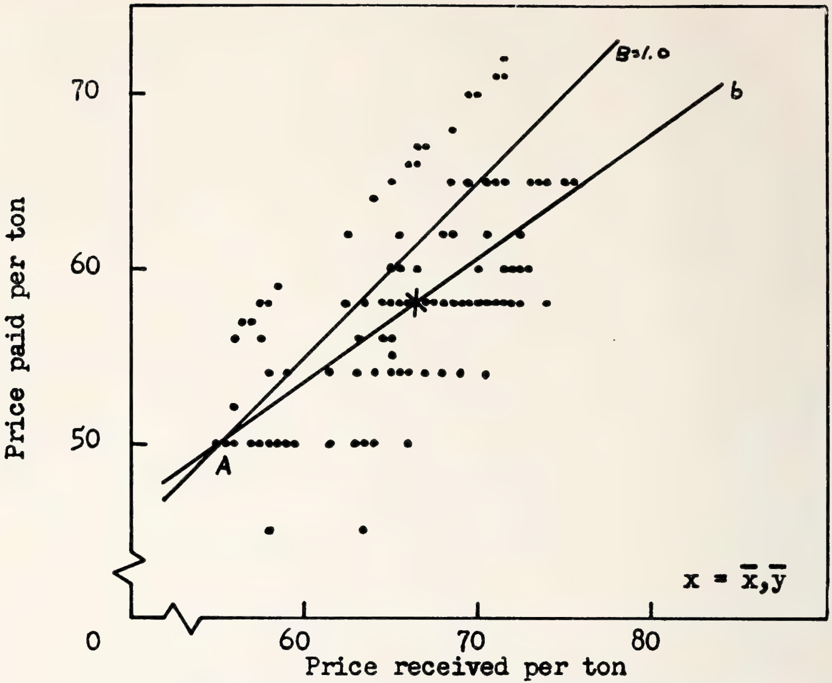
The analysis was first performed for each district and each year individually. The data were later combined for further analysis. Pooled regressions were computed and the significance of the reduction of the error sum of squares by using individual regressions was tested. This was done to discover if a significant difference existed in pricing errors among districts and between seasons. Where differences were not significant, it indicated that pricing errors over the observed range of the data were similar for the groups being tested.

To simplify presentation, the average price paid was adjusted by adding a constant margin of $5.00 per ton. This represented the margin generally accepted as adequate by the ginners in Louisiana and approximately equaled the average difference between prices paid and received in the study. In diagramming the computed and unbiased regression lines, the unbiased regression line was adjusted to reflect the effect of the $5.00 margin for handling seed.

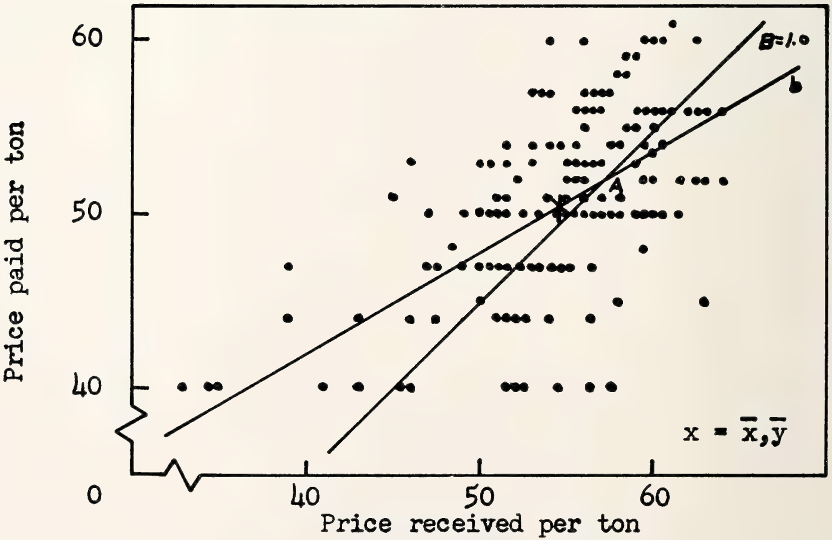
District I

The adjusted average price per ton paid to producers by ginners for cottonseed in District I was $63.21 during 1956 and $55.47 during 1957. The average price per ton received for cottonseed by ginners from the oil mill was $66.20 and $54.45 for the two seasons, respectively. The difference of —$2.99 for 1956 was highly significant, while the difference of +$1.02 for 1957 was not (Table 1). This indicates that on the average there was a downward bias in the prices paid by ginners in 1956 whereas there was no significant bias in the average prices paid during 1957. The negative difference in 1956 indicates that on the average the prices paid by ginners were $7.99 below the prices received, or $2.99 in excess of the constant margin. The positive difference in 1957 was not significant and may be attributed to reasonable sampling fluctuations.

The computed linear regression coefficient was 0.7115 for 1956 and 0.5832 for 1957. Tests revealed these coefficients were significantly different from 0 and from 1.0, indicating a significant but imperfect relationship between the prices paid and received. The computed regression line for 1956 lies below the unbiased regression line ($B=1.0$) throughout the range of the data, indicating an average downward bias in prices paid by ginners throughout the season (Figure 1). The computed regression line and the unbiased line become wider apart as they move upward to the right. This means that on the average the lower valued seed were not underpriced as much as the higher



188 lots of cottonseed, District I, 1956



211 lots of cottonseed, District I, 1957

Figure 1.—Relationship between prices paid and actual prices received for cottonseed.

valued seed. The scatter of dots about the unbiased regression line indicates that substantial pricing errors occurred during 1956 under the present pricing system.

The unbiased regression line for 1957 crosses the computed regression line very close to the means $\bar{x}, \bar{y}$ at point A (Figure 1). This indicates that the average price paid by ginners for cottonseed during 1957 was not biased. However, the computed regression line lies above the unbiased regression line to the left of point A and below to the right of it. This indicates that on the average the lower valued seed were overpriced and the higher valued seed were underpriced. The scatter of dots about the unbiased line indicates substantial pricing errors during 1957. However, the dots were more evenly distributed above and below the line than for 1956.

Approximately 41 percent of the variation in the prices paid for cottonseed was linearly associated with the prices received from the oil

TABLE 1.—Summary analysis of regression of price paid on price received for cottonseed by ginners and price errors, District I, by years[a]

Items measured or computed	Number of observations		
	Dist. I 1956 188	Dist. I 1957 211	Dist. I 1956-57 399
Price paid by ginner:			
Mean	58.21	50.47	54.12
Adjusted mean[b]	63.21	55.47	59.12
Standard deviation	5.49	5.47	6.70
Price received by ginner			
Mean	66.20	54.45	59.98
Standard deviation	4.94	5.49	7.89
Correlation coefficient	0.6405**	0.5939**	0.7641**
Coefficient of determination	0.4102	0.3527	0.5838
Regression coefficient	0.7115	0.5832	0.6486
Total sum of squares	5,645.49	6,276.61	17,876.23
Reduction in S.S. due to reg.[c]	2,315.53	2,213.45	10,435.76
Deviations from reg. S.S.	3,329.96	4,063.16	7,440.47
Variance of estimate S^2e	17.90	19.44	18.74
Standard error of estimate	4.231	4.409	4.329
Standard error of reg. coef.	0.00625	0.00547	0.0275
(t) value for test Ho:b=1	4.62**	8.17**	12.78**
(t) value for test Ho:b=0	11.39**	10.67**	23.59**
Mean difference (error)	—2.99	+1.02	—.86
Standard deviation	5.23	5.52	7.32
Standard error of mean	0.5390	0.537	0.5184
(t) value for test of hypothesis true mean difference = 0	—5.547 **	+1.899	—1.6589

[a] Error equals adjusted price paid minus price received.

[b] Average price paid plus $5.00 margin.

[c] S.S. equals sum of squares.

** Signiifcant at .01 level.

mill during 1956 as compared with 35 percent during 1957. The standard error of estimate was $4.23 and $4.41 for the two years, respectively (Table 1). The standard error is a measure of the variation in price around the computed regression line. It indicates that two-thirds of the observations will not vary above or below the line by more than this amount.

District II

The adjusted average price paid for cottonseed in District II was $55.79 during 1956 and $58.35 during 1957. The average price received was $63.17 and $56.52 for the two seasons, respectively. The differences of −$7.38 and +$1.83 were found to be significant (Table 2). This indicates that on the average there was a downward bias in the prices paid by ginners during 1956 and an upward bias in prices during 1957. The average pricing error for 1956 was considerably larger than that found in any of the other districts for the two seasons included in the study.

The computed regression coefficient was 0.4407 for 1956 and −0.0565 for 1957. Tests indicated that both coefficients differed significantly from 1.0. However, only the 1956 coefficient tested significantly different from 0. This indicates that there was a significant relationship between prices paid and received during 1956 and that there was no relationship between the two variables during the 1957 season. However, in view of the significant relationship between the two variables in other districts during both seasons and the small number of observations available from District II, it was felt that the test did not give a true picture for this area during 1957. Snedecor[10] has emphasized that sample values from a bivariate population may be quite variable if N is small.

The computed regression line for 1956 lies below the unbiased line (B = 1.0) throughout the range of the data, indicating a downward bias in all prices paid (Figure 2). The two regression lines become wider apart as they move upward to the right, indicating that the pricing error for lower valued seed was less than that for higher valued seed. Although the data indicate no significant relationship between the variables during 1957, a majority of the observations lie above the unbiased regression line, indicating that on the average the prices paid had an upward bias (Figure 2).

Approximately 71 percent of the variation in the prices paid for cottonseed was linearly associated with the prices received from the oil mill during 1956, as compared to only 2 percent during 1957 (Table 2). It may be pointed out, however, that there were only 3 different prices paid for cottonseed in District II during the 1957 season. The standard error of estimate was $1.72 and $1.02 for the two seasons, respectively.

---

[10] Snedecor, George W., *op. cit.*, p. 141.

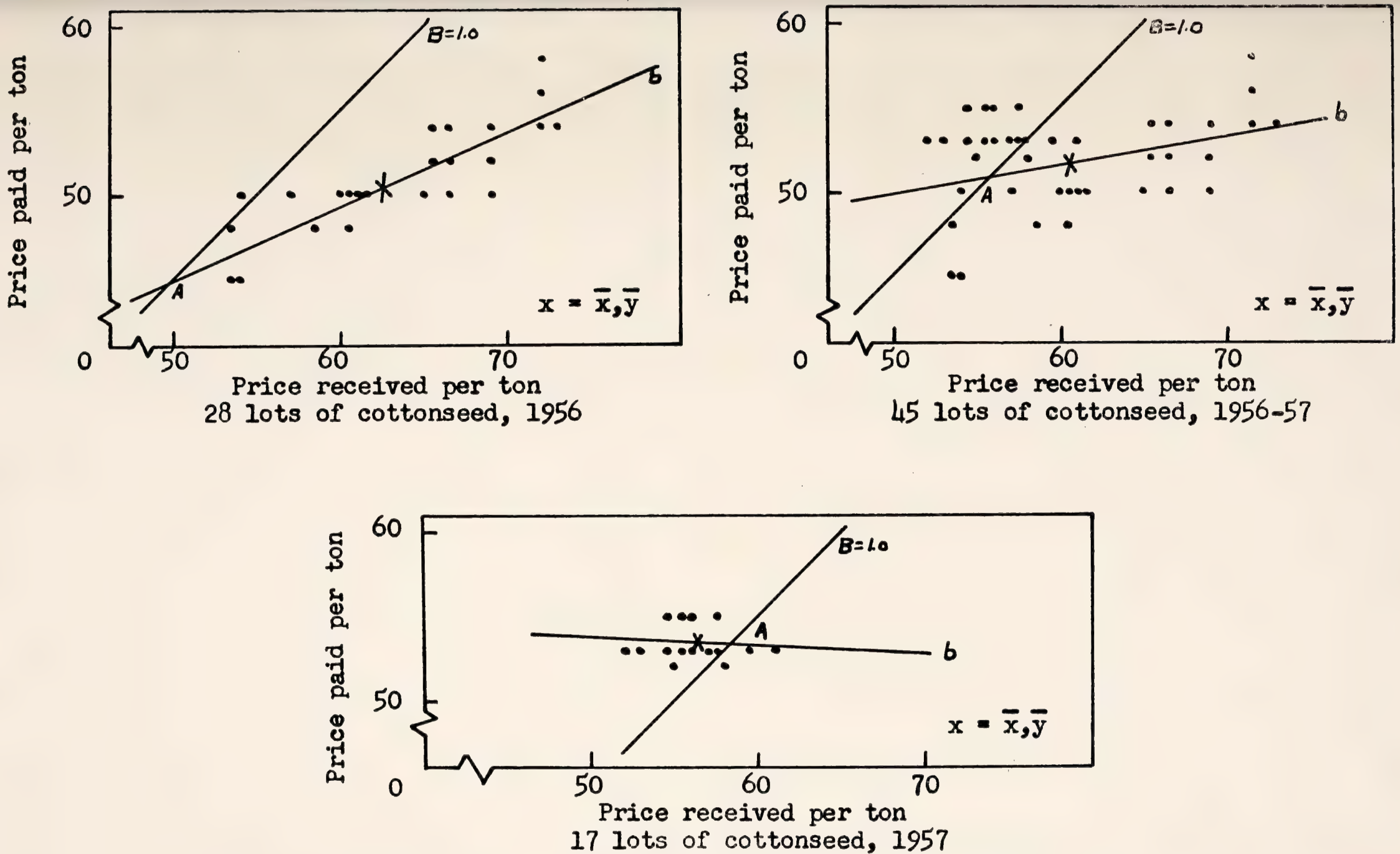


Figure 2.—Relationship between prices paid and actual prices received for cottonseed, District II.

TABLE 2.—Summary analysis of regression of price paid on price received for cottonseed by ginners and price errors, District II, by years.[a]

Items measured or computed	Number of observations Dist. II 1956 28	 Dist. II 1957 17	 Dist. II 1956-57 45
Price paid by ginner:			
Mean	50.79	53.35	51.76
Adjusted mean[b]	55.79	58.35	56.76
Standard deviation	3.13	0.99	2.82
Price received by ginner:			
Mean	63.17	56.52	60.66
Standard deviation	5.99	2.36	5.89
Correlation coefficient	0.8427**	0.0133	0.3294*
Coefficient of determination	0.7101	0.0176	0.1085
Regression coefficient	0.4407	—0.0565	0.1578
Total sum of squares	264.71	15.88	350.31
Reduction in S.S. due to reg.[c]	187.96	.28	38.01
Deviations from reg. S.S.	76.75	15.60	312.30
Variance of estimate S^2e	2.95	1.04	7.26
Standard error of estimate	1.718	1.02	2.694
Standard error of reg. coef.	0.0552	0.0342	0.0690
(t) value for test Ho:b=1	10.13**	30.89**	12.21**
(t) value for test Ho:b=0	7.98**	1.65	2.29*
Mean difference (error)	—7.38	+1.83	—4.90
Standard deviation	4.78	1.81	4.62
Standard error of mean	1.2769	0.6207	0.9733
(t) value for test of hypothesis true mean difference = 0	—5.7796**	+2.948**	—5.0334**

[a] Error equals adjusted price paid minus price received.
[b] Average price paid plus $5.00 margin.
[c] S.S. equals sum of squares.
* Significant at .05 level.
**Significant at .01 level.

District III

The adjusted average price paid by ginners for cottonseed in District III was $56.68 during 1956 and $51.10 during 1957. The average price received was $58.02 and $49.36 for the two seasons, respectively. The differences of —$1.34 and +$1.74 were both significant at the 1 percent level (Table 3). This means that there was a downward bias in prices paid by ginners during 1956 and an upward bias during 1957. The negative error for 1956 indicates that on the average the prices paid were $1.34 in excess of the $5.00 constant margin. The positive error during 1957 indicates that on the average prices paid fell short of maintaining the $5.00 margin by $1.74.

The computed linear regression coefficients for 1956 and 1957 were 0.6428 and 0.5349. Both coefficients tested significantly different from

0 and 1.0, indicating a significant but imperfect relationship between the variables.

The means $\bar{x}, \bar{y}$ on the computed regression line for 1956 lie below the unbiased regression line ($B = 1.0$) and to the right of point A where the two lines cross (Figure 3). This indicates that on the average the prices paid were biased downward. However, since the two regression lines cross, this means that on the average the lower valued seed were overpriced while the higher valued seed were underpriced. A majority of the dots are located below the unbiased regression line, indicating that most of the errors were in terms of underpricing. Some individual lots were underpriced as much as $10.00 per ton.

The means $\bar{x}, \bar{y}$ on the computed regression line for 1957 lie above the unbiased regression line and to the left of point A where the two lines cross (Figure 3). This indicates that on the average the prices paid were biased upward. However, since the two regression lines cross, this means that on the average seed to the right of point A were underpriced while those to the left of it were overpriced. The scatter of the dots about the unbiased regression line indicates substantial pricing errors in District III during 1957. Some individual lots of seed were underpriced as much as $23.00 per ton while others were overpriced as much as $35.00 per ton.

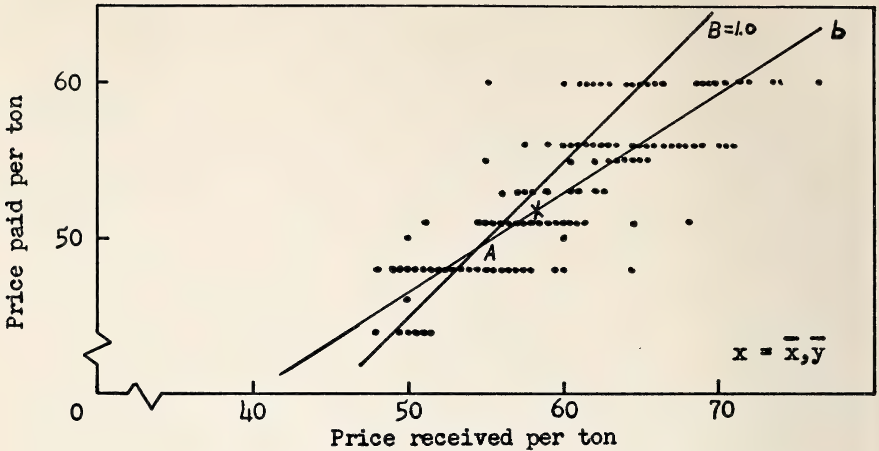
Seventy-three percent of the variation in the prices paid for cottonseed was linearly associated with the prices received from the oil mill during 1956; only 27 percent was associated with prices received during 1957. The standard error of estimate was $2.39 during 1956 and $5.69 during 1957.

Combined Analysis

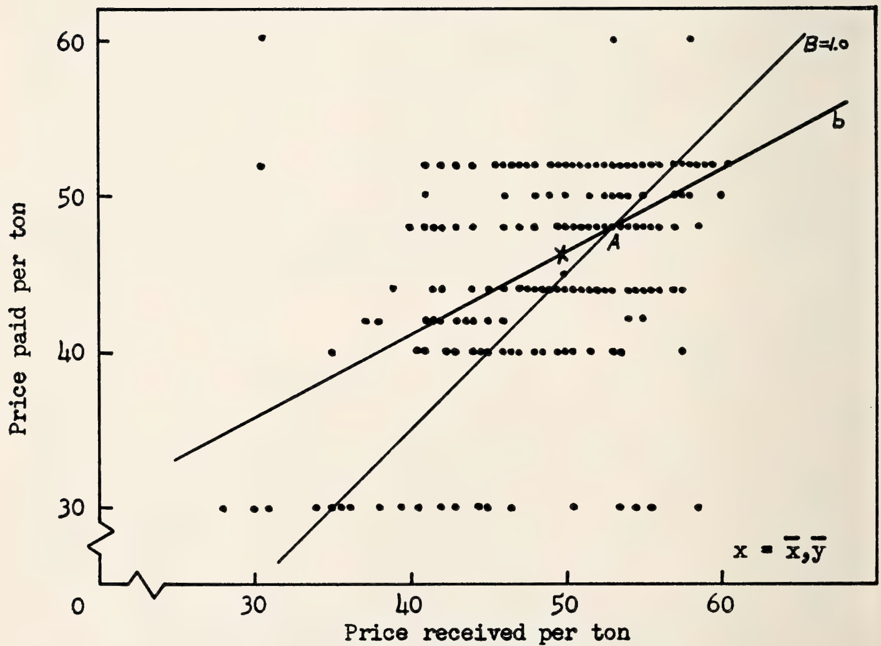
The adjusted average price paid for cottonseed for the two-year period was $59.12 in District I and $54.14 in District III. The average price received from the oil mill was $59.98 and $54.07 for the two districts, respectively (Tables 1 and 3). The differences of —$0.86 and +$0.07 were not found to be significant, indicating that there was no significant bias in the average prices paid for seed by ginners in either district over the two-year period of the study.

The average linear regression coefficient was 0.6486 for District I and 0.6087 for District III. Both regression coefficients were found to be significantly different from 0 and from 1.0, indicating a significant but imperfect relationship between the two variables.

The means $\bar{x}, \bar{y}$ of the computed linear regression line for District I lie slightly to the right of point A where the computed regression line intersects the unbiased regression line ($B = 1.0$) (Figure 4). This con-



358 lots of cottonseed, District III, 1956



300 lots of cottonseed, District III, 1957

Figure 3.—Relationship between prices paid and actual prices received for cottonseed.

TABLE 3.—Summary analysis of regression of price paid on price received for cottonseed by ginners and pricing errors, District III, by years[a]

Items measured or computed	Number of observations		
	Dist. III 1956 358	Dist. III 1957 300	Dist. III 1956-57 658
Price paid by ginner:			
Mean	51.68	46.10	49.14
Adjusted mean[b]	56.68	51.10	54.14
Standard deviation	4.62	6.64	6.28
Price received by ginner:			
Mean	58.02	49.36	54.07
Standard deviation	6.16	6.44	7.62
Correlation coefficient	0.8569**	0.5184**	0.7386**
Coefficient of determination	0.7342	0.2687	0.5456
Regression coefficient	0.6428	0.5349	0.6087
Total sum of squares	7,623.33	13,194.20	25,913.69
Reduction in S.S. due to reg.[c]	5,597.37	3,545.17	14,138.59
Deviation from reg. S.S.	2,025.96	9,651.03	11,775.10
Variance of estimate S^2e	5.69	32.39	17.95
Standard error of estimate	2.385	5.691	4.237
Standard error of reg. coef.	0.0205	0.0511	0.0230
(t) value for test Ho:b=0	17.42**	9.09**	17.00**
(t) value for test Ho:b=0	31.36**	10.46**	26.44**
Mean difference (error)	—1.34	+1.74	+.07
Standard deviation	5.44	6.54	6.98
Standard error of mean	0.4070	0.5340	0.3850
(t) value for test of hypothesis true mean difference = 0	—3.292**	+3.584**	+0.18

[a] Error equals adjusted price paid minus price received.
[b] Average price paid plus $5.00 margin.
[c] S.S. equals sum of squares.
**Significant at .01 level.

firms the fact that the means were not significantly different. The computed regression line lies above the unbiased line to the left of point A and below it to the right. This indicates that ginners tended to overprice seed lower in value than that in the neighborhood of point A and to underprice seed higher in value. The scatter of the dots about the unbiased regression line indicates substantial pricing errors for individual lots of seed.

A similiar relationship existed between the computed regression line for District III and the unbiased regression line (Figure 5). On the average, seed with values lower than the mean were overpriced, while those valued above the mean were underpriced. The scatter of dots about the unbiased regression line indicates substantial pricing errors for individual lots of seed.

Approximately 58 percent of the variation in the prices paid for seed in District I and 55 percent in District III was linearly associated with

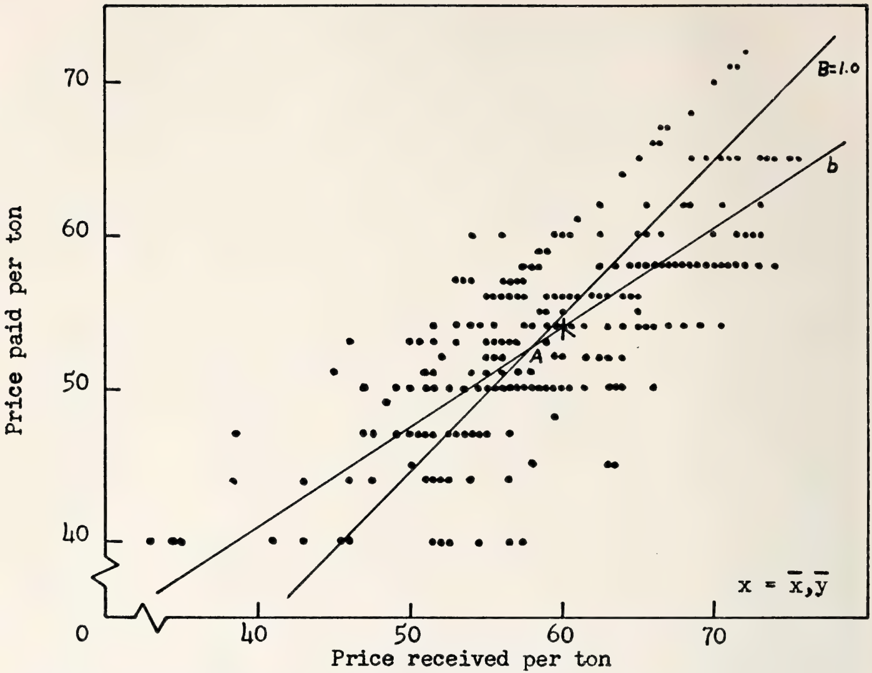


Figure 4.—Relationship between prices paid and actual prices received, 399 lots of cottonseed, District I, 1956-57.

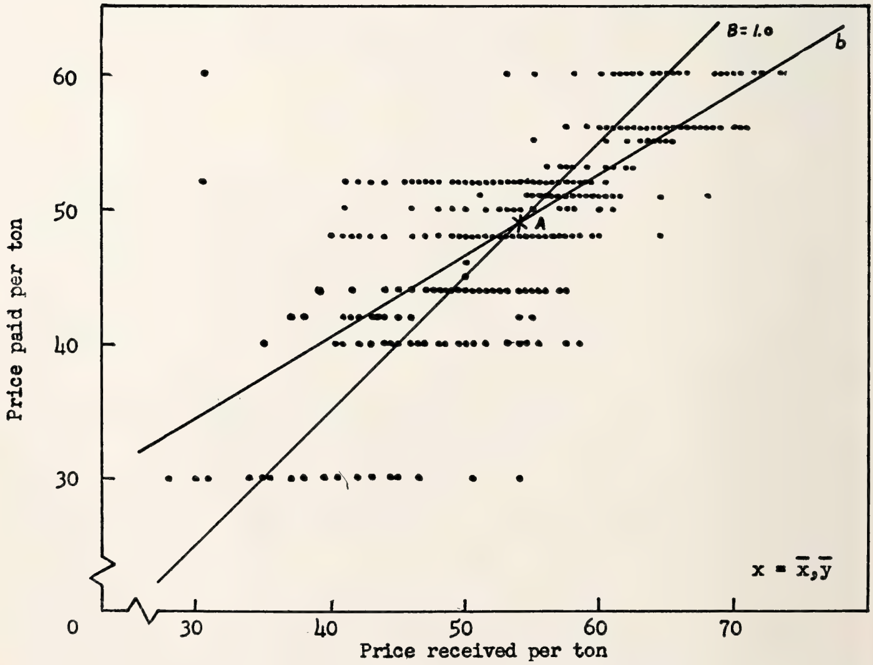


Figure 5.—Relationship between prices paid and actual prices received, 658 lots of cottonseed, District III, 1956-57.

the prices received from the oil mill. The standard error of estimate was \$4.33 and \$4.24 for the two districts, respectively (Tables 1 and 3).

The analysis of the combined data for District II indicated a significant downward bias in average prices paid. However, the computed regression coefficent was significant only at the 5 percent level (Table 2). Interpretation of the data was limited by the relatively small number of observations. The graphic relationship is shown in Figure 2.

In order to ascertain the overall pricing errors for the two seasons and three districts as a whole, all of the observations were pooled for analysis. In referring to these data it must be remembered that they are representative of all observations only and would not be applicable to the individual districts.

The adjusted average price paid for cottonseed was \$58.78 during 1956, \$53.08 during 1957 and \$56.05 for the two seasons combined. The corresponding average prices received were \$60.95, \$51.63 and

TABLE 4.—Summary analysis of regression of price paid on price received for cottonseed by ginners and pricing errors, all districts, by years[a]

Items measured or computed	Number of observations		
	All Dist. 1956 574	All Dist. 1957 528	All Dist. 1956-57 1,102
Price paid by ginner:			
Mean	53.78	48.08	51.05
Adjusted mean[b]	58.78	53.08	56.05
Standard deviation	5.77	6.51	6.76
Price received by ginner:			
Mean	60.95	51.63	56.48
Standard deviation	6.93	6.55	8.20
Correlation coefficient	0.8206**	0.6063**	0.7704**
Coefficient of determination	0.6733	0.3676	0.5935
Regression coefficient	0.6831	0.6027	0.6354
Total sum of squares	19,050.90	22,348.66	50,332.45
Reduction in S.S. due to reg.[c]	12,827.28	8,214.59	29,874.16
Deviations from reg. S.S.	6,223.62	14,134.07	20,458.29
Variance of estimate S^2e	10.88	26.87	18.598
Standard error of estimate	3.298	5.184	4.313
Standard error of reg. coef.	0.0199	0.0344	0.0159
(t) value for test Ho:b=1	15.93**	11.53**	21.99**
(t) value for test Ho:b=0	34.34**	17.48**	40.00**
Mean difference (error)	—2.17	+1.45	—.43
Standard deviation	6.37	6.53	7.51
Standard error of mean	0.3762	0.4020	0.3201
(t) value for test of hypothesis true mean difference = 0	—5.768**	+3.607**	—1.344

[a] Error equals adjusted price paid minus price received.
[b] Average price paid plus \$5.00 margin.
[c] S.S. equals sum ot squares.
**Significant at .01 level.

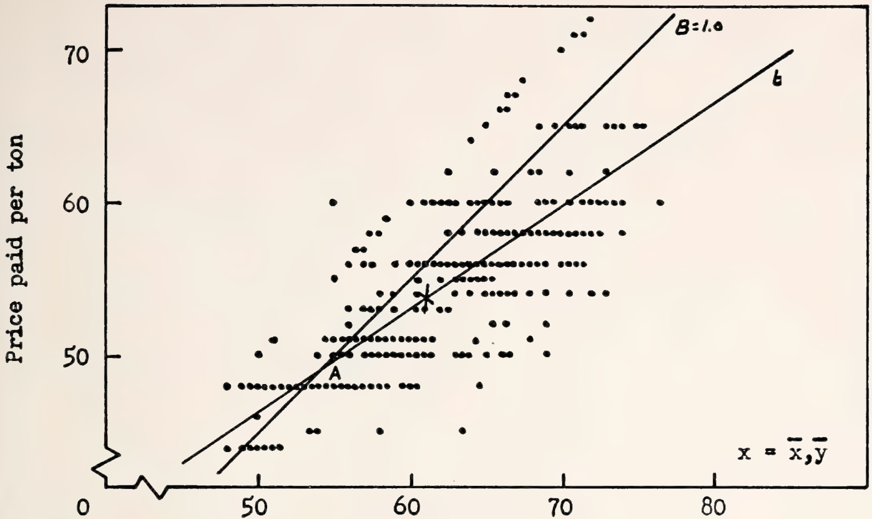
\$56.48. The difference of —\$2.17 in 1956 and +\$1.45 in 1957 was significant at the 1 percent level while the average difference for the two seasons of —\$.43 was not significant. This indicates that on the average there was a downward bias in prices paid by ginners in 1956 and an upward bias in 1957. For the two seasons as a whole, there was no bias in the average prices paid for seed.

The computed linear regression coefficient was 0.6831 for 1956, 0.6027 for 1957 and 0.6354 for the two seasons combined. Tests revealed that all of the coefficients were significantly different from 0 and from 1.0 (Table 4). This means that there was a significant but imperfect relationship between the prices paid and received for cottonseed by ginners. The means $\bar{x}$, $\bar{y}$ of the computed regression line for 1956 lie above and to the right of the point where the computed line crosses the unbiased regression line. The means lie below and to the left of the point where the two lines cross for 1957 and slightly above and to the right for both seasons combined (Figures 6 and 7). A larger proportion of the seed was underpriced than overpriced in 1956 and the opposite situation existed in 1957. For the two seasons combined approximately equal proportions of seed were under and overpriced.

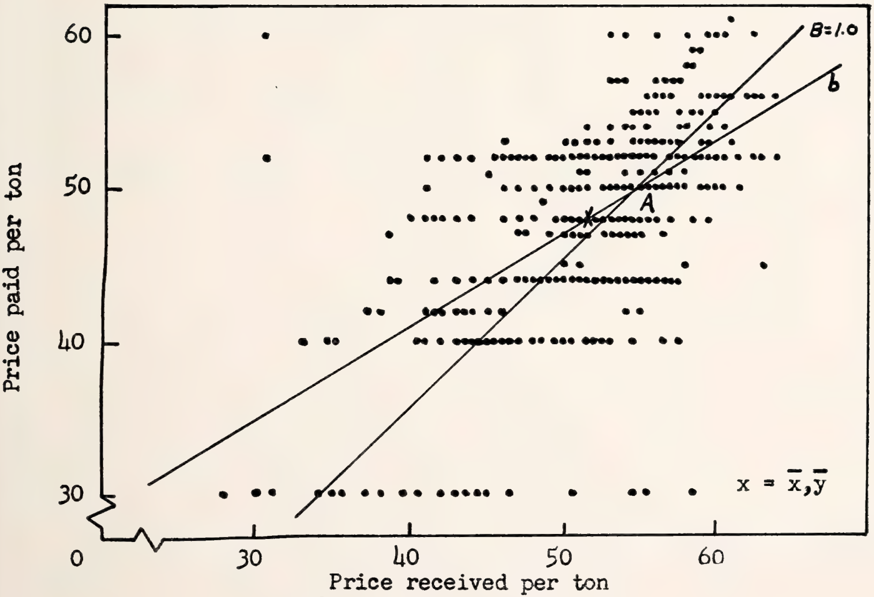
The standard deviations of the means for prices paid were not as large as those for prices received. This indicates that the prices paid did not cover as wide a range as prices received.

There was a considerably higher association between prices paid and received during 1956 than in 1957. Approximately 67 percent of the variation in the prices paid for seed in 1956 was linearly associated with prices received, compared to 37 percent in 1957. For the two seasons combined 59 percent of the variation in prices paid was linearly associated with prices received. The standard error of estimate was also higher in 1957 than in 1956—\$5.18 and \$3.30, respectively. The standard error for the two seasons combined was \$4.31 (Table 4).

Since the analysis is based upon data consisting of shipments to oil mills by gins, it is most useful in evaluating the pricing errors for such lots. Data were not available to determine the grade and actual value of each individual bale lot of seed comprising each shipment. This is an additional source of error in the present pricing system. This error would be measured by the extent to which the grades of individual bale lots might vary from the average grade of the entire shipment. Thus, the present pricing system is subject to two types of errors—one in the form of its failure to reflect accurately the prices received from the oil mill for each shipment, and the second in the form of the failure of the gin price to reflect variations in the value of individual bale lots making up each shipment.



574 lots of cottonseed, 1956



528 lots of cottonseed, 1957

Figure 6.—Relationship between prices paid and actual prices received for cottonseed.

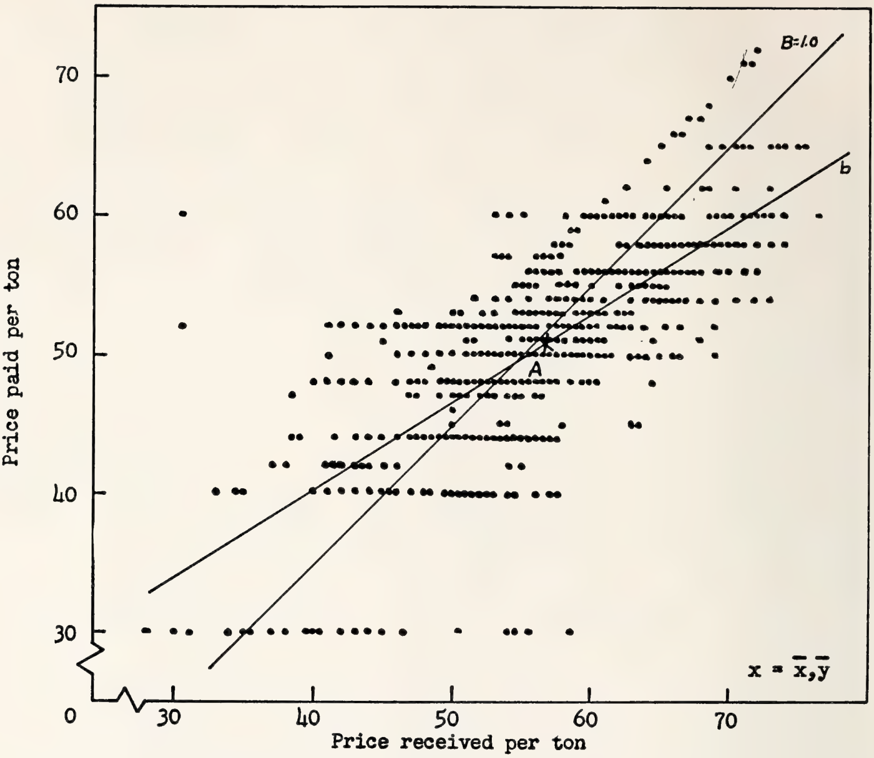


Figure 7.—Relationship between prices paid and actual prices received, 1102 lots of cottonseed, 1956-57

The analysis indicates that the present pricing system provides only a small and uncertain incentive for producers to produce high-grade cottonseed. The producer of high-grade seed gets the same amount for his seed as the producer of low-quality seed under the present flat price system. In addition, the tendency of gin prices to underprice high-quality and overprice low-quality seed tends to penalize producers during periods when seed quality is high and give them unearned benefits during periods of low-quality seed production.

The present pricing system involves an element of risk for the ginner. He purchases seed from producers on the basis of an estimate of what he thinks the quality will be. However, his sales of cottonseed to the oil mill are based on an official grade analysis of the seed. The pricing errors in the present system indicate that this element of risk is quite large.

Pooled Regressions

The analysis of variance technique was used to test the difference between the regression coefficients for the two seasons in each district and for the three districts each season.[11] The regressions were first tested to ascertain if one regression line could be used to represent both seasons. If the difference between the coefficients was found to be significant, a second test was made to ascertain if the slopes of the regression lines were significantly different. A similar procedure was used to test differences among districts.

The difference between regression coefficients for the two seasons was not found to be significant in District I or for all districts combined. The differences were significant at the 5 percent level in District III and highly significant in District II (Table 5). The differences between the regression coefficients for all other combinations of years and districts were found to be highly significant except Districts I and II for 1957. This indicated that the pricing errors were different among districts and somewhat different between seasons.

TABLE 5.—Analysis of variance of regression coefficients: values of F for tests of of hypothesis about regression coefficients

Source of variation	d.f.	Can one reg. line be used?	d.f.	Are slopes of reg. lines equal?
All years:				
Districts I, II, III	4-1096	13.05**	2-1096	9.77**
Districts I, II	2-440	18.71**	1-440	19.65**
Districts II, III	2-699	10.53**	1-699	17.24**
District I, III	2-1053	10.61**	1-1053	1.31
1956:				
Districts I, II, III	4-568	20.68**	2-568	3.16*
Districts I, II	2-212	18.04**	1-212	2.49
Districts II, III	2-382	42.08**	1-382	6.71**
District I, III	2-542	6.25**	1-542	1.63
1957:				
Districts I, II, III	4-522	3.85**	2-522	0.77
Districts I, II	2-224	2.24	1-224	1.97
Districts II, III	2-313	19.58**	1-313	0.61
District I, III	2-507	4.99**	1-507	0.29
District I:				
1956, 1957	2-395	1.26	1-395	2.36
District II:				
1956, 1957	2-41	48.88**	1-41	8.95**
District III:				
1956, 1957	2-654	2.75*	1-654	4.11*
All Districts:				
1956, 1957	2-1098	2.71	1-1098	4.33

* Significant at .05 level.
** Significant at .01 level.

---

[11] Ostle, Bernard. Statistics in Research. Ames, Iowa, Iowa State College Press. 1954. For a full discussion of the method used see pp. 133-138.

ALTERNATIVE PRICING SYSTEMS

The precision of any marketing system in reflecting the value of a product to the owner is limited by the cost of determining the differences in value. Precision cannot be carried beyond the point where the cost of determining the differences is greater than the differences themselves. Thus, in evaluating any alternative pricing system, one must consider its effect on both pricing efficiency and operational efficiency. The relationship between the two will determine whether or not the alternative system warrants adoption.

Several methods of pricing cottonseed at the ginner market could be used. The estimation of grades by ginners and the resulting pricing errors in the present system suggest the need for alternatives which more accurately reflect grade variations in prices. Three such alternatives would be to market cottonseed on the basis of (1) the actual grade of each individual bale lot of seed; (2) the grade of seed in each shipment to the oil mill, and (3) an estimate of the grade of each individual lot based on the measurement of one or more of the factors affecting grade. In considering each of the alternatives, it is assumed that the present official grading system accurately reflects the true quality differences in cottonseed, that the oil mill base price accurately reflects consumer demand for cottonsed products and that the premiums and discounts for grade above and below the basis grade accurately reflect the value differences between grades.

Actual Grades

The optimum in pricing efficiency would be achieved if each individual bale lot of cottonseed were sold on the basis of its grade. This would involve taking a sample of each bale lot of seed, having an official grade analysis made and pricing the seed on the basis of its grade and the oil mill base price at the time of sale. Since the present system of grading is too elaborate, too expensive and time consuming for use on the small lots of cottonseed purchased by the ginner from producers, this method is clearly impractical at this time.

Grade of Each Shipment

Optimum pricing efficiency would be achieved by this method in so far as reflecting the variation in prices received by ginners is concerned. It would be something less than the optimum in terms of pricing efficiency for individual lots of cottonseed. Pricing errors would be present to the extent that the grades of the individual lots varied from the grade of the shipment. One might expect this error to be quite small in areas where varieties, soils, cultural practices, and growing and harvesting conditions were highly uniform. In practice, the use of this system would mean that the ginner would have to delay settlement on his purchase of seed until he obtained the official grade analysis and oil mill price on each shipment or make a partial payment at the time of ginning, with a final settlement after the grade analysis was obtained. This would involve considerable change from the present custom of deducting the ginning charge from the seed payment and making immediate settlement for the balance. No data are available at the present time to ascertain the variability in grade of individual lots of seed making up a shipment. Such data are necessary in order to determine the extent of the pricing errors involved in the use of such a system. Although this method would be an improvement over the present system, the problems associated with changing to the system and the fact that it does not eliminate pricing errors for individual lots leave much to be desired.

Estimated Grades

Purchasing cottonseed at the gin on the basis of estimated grades would have the advantage of reflecting variations in individual lots of seed and at the same time would lend itself to practical application. Pricing errors would be limited to the extent of the errors in estimating grades. The analysis of three such systems of estimating grade and the resulting reductions in pricing errors as compared with the present system are discussed in the following sections.

ALTERNATIVE METHODS OF ESTIMATING COTTONSEED GRADES

The present standards for grades of cottonseed sold or offered for sale for crushing purposes within the United States specify that the grade of cottonseed be obtained by multiplying a quantity index by a quality index and dividing the result by 100.[12] The standards specify that the quantity index be determined by the percentage of oil and ammonia in the seed plus an applicable linters premium or discount. They specify that the quality index be determined by the percentage of foreign matter and moisture in the seed and the percentage of free fatty acids in the oil in the seed. The six factors affecting cottonseed grade under the present standards, therefore, are: percentages of oil, ammonia, foreign matter, and moisture in the seed, the percentage of free fatty acids in the oil, and a linters factor.

---

[12] U. S. Department of Agriculture, Agricultural Marketing Service, Cotton Division. Standards for Grades of Cottonseed Sold or Offered for Sale for Crushing Purposes Within the United States. Service and Regulatory Announcement No. A.M.S. 179. April 1958. pp. 1-4.

The approach to the development of the grade estimates was guided by the hypothesis that some of the factors affecting grade have a higher relationship to grade than others. A second hypothesis was that certain grade factors are correlated with grade sufficiently to be used to estimate grade. An important consideration in the selection of the grade factors was the practicability of their application and use in actual practice.

Multiple regression analysis of the effects of the various grade factors on the grade of cottonseed has shown that oil quality (free fatty acid) is the most important and quantity of oil is the second most important factor affecting grade. Moisture and ammonia content ranked third and fourth, respectively, while foreign matter content was found to have a negligible effect on cottonseed grade. The linters content was not a factor of grade at the time the analysis was made.

The United States Department of Agriculture has been working to develop an economical method of seed analysis to be used at the cotton gin. Up to the present time satisfactory methods of analysis have been developed to determine the oil[13] and moisture[14] content of the seed, but no complete method of grade analysis is available.

As indicated above, oil and moisture are two of the more important factors affecting grade. Oil content is an important factor in determining the quantity index while moisture content is an important factor in determining the quality index.

These developments suggest three possible alternative methods of estimating cottonseed grades at the gin based on (1) the moisture content alone, determined by use of the electrical conductivity method; (2) the oil content alone, determined by the dielectric method, or (3) a combination of both oil and moisture contents. Separate regression analyses were calculated for each of the possible alternatives. Scatter diagrams were also used to ascertain the relationship of the factors to grade.

Regression of Grade and Moisture Content

Moisture determinations through the use of the USDA moisture meter are simply and quickly performed. Its use would require less in the way of operational changes than either the use of the oil meter alone or the use of both meters together. Even though moisture ranked third in importance as a factor affecting grade, these operational efficiency aspects suggest it be given first consideration as a basis of grade estimation.

---

[13] Whitten, Marion E., and Holaday, Charles E. Rapid Method for Determining the Oil Content of Cottonseed. U. S. Department of Agriculture, Agricultural Marketing Service, Cotton Division. AMS-72. 1955.

[14] Whitten, Marion E., and Holaday, Charles E. Electric Meter for Rapid Measurement of Moisture in Cottonseed. U. S. Department of Agriculture, Agricultural Marketing Service, Cotton Division, Marketing Research Report 162. 1957.

It was impossible to obtain actual oil and moisture determinations through the use of the two meters for this phase of the study. The cost of obtaining such data would have exceeded the funds available for the study. The oil and moisture contents as determined by the official methods were obtained from the official grade analysis of each lot of seed included in the study. Since the meters have been recommended as alternatives to the present official methods of oil and moisture determination, it was assumed that official determinations would approximate those that would have been obtained if the meters themselves had been used. Differences in determinations between the two methods would be a source of error in the analysis.

In the first stages of the analysis the data were examined by graphical methods. The grade-moisture content data for observations in the three districts and two seasons were plotted on separate graphs. The scatter diagrams showed a pattern of negative relationship between grade and moisture content. However, the relationship differed greatly between seasons. When all of the observations were combined into one scatter diagram, it formed a curved, horn-shaped distribution of dots. There was a relatively small scatter of dots at the upper left hand part of the diagram and the scatter became wider as it curved downward to the right (Figure 8).

Neither a linear nor a curvilinear relationship tended to fit the data very closely. There was considerable variation about the free-hand fitted lines. Since it was not possible to determine these relationships precisely from the graphs, least squares regression techniques were used to derive more definitive and meaningful measures of the association between grade and moisture.[15] Neither the linear nor the curvilinear regressions were found to fit the data satisfactorily.

The fact that oil quality (free fatty acid content) was the most important grade factor and that the average acid content was considerably higher during the 1957 season than in the 1956 season indicated that it may be exerting an influence on the grade-moisture relationships. Appraisal of supplemental data and further graphic analysis indicated a natural grouping of the data into three groups based upon their free fatty acid content as follows: (1) seed containing 2 percent or less free fatty acid, (2) seed containing 2.1 to 4.9 percent free fatty acid and (3) seed containing 5 percent or more free fatty acid. It was found that only during abnormal seasons would there be any appreciable amount of seed

---

[15] Snedecor, George W. Statistical Methods. Fourth Edition. Ames, Iowa, Iowa State College Press. 1953. For discussion of method used see pp. 103-124.

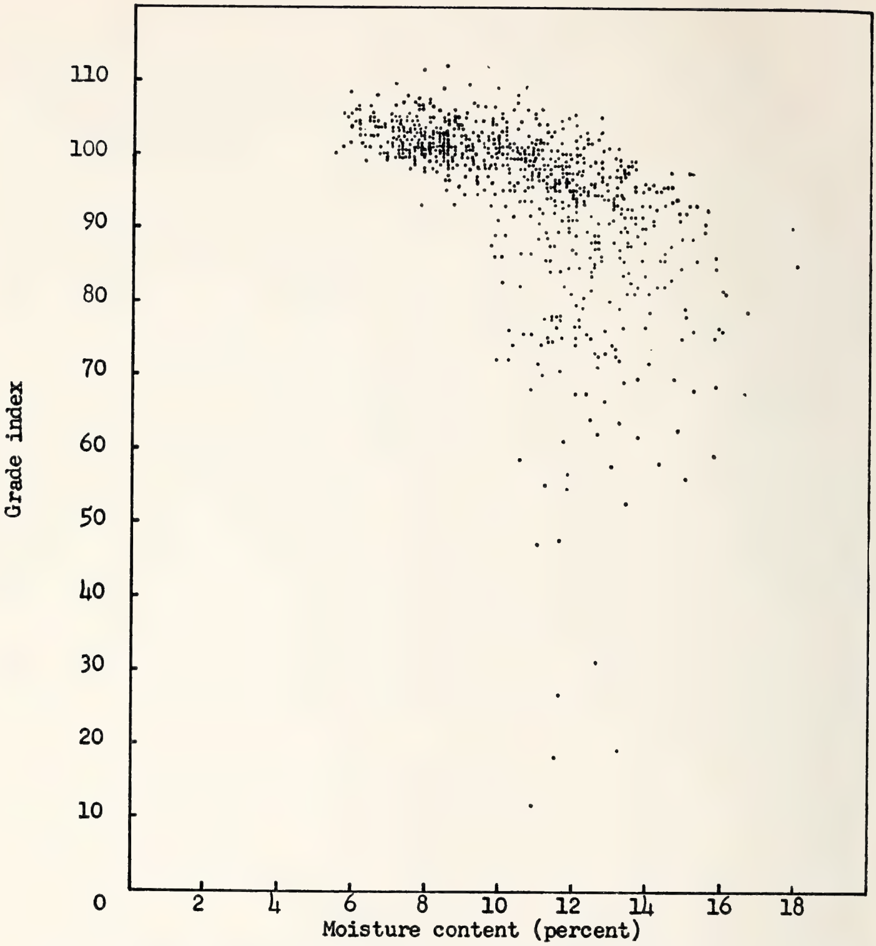


Figure 8.—Relationship between moisture contents and grades, 1,102 lots of cottonseed.

containing 5 percent or more free fatty acids. During normal seasons in Louisiana one could expect 90 percent or more of the seed to contain less than 2 percent free fatty acid.

It was further noted that the average free fatty acid content of seed during any season tended to increase as the season progressed and in normal seasons one could expect acid contents exceeding 2 percent to occur only in the latter part of the ginning period. The acid content of seed in the 5 percent or more free fatty acid group ranged as high as 31 percent. However, the number of observations of the higher acid content seed were inadequate to make any further breakdown in the data for this group. In addition, the fact that no method was available for the gin determination of the free fatty acid content made it impractical to subdivide the data further. It is anticipated that ginners will be able to ascertain the changes in free fatty acid content from one group to another fairly accurately through contacts with the oil mill, other ginners and their own official grade returns on oil mill shipments throughout the season.

Scatter diagrams of the data for the three groups showed a negative linear pattern of relationship between moisture and grade in all except the 5 percent or more acid group. No relationship could be ascertained for this group because of the wide scatter of observations. Single variable linear regressions of grade on moisture content were computed for each free fatty acid grouping. In addition, the variance of the estimate, standard error of estimate, correlation coefficient and coefficient of determination were calculated. The standard error of the estimate was reduced from 9.81 to 2.83 for the 2 percent or less free fatty acid group as compared with that of the regression involving all observations; the standard error of the 2.1 to 4.9 percent group was reduced to 7.50 (Table 6). No significant relationship was found between moisture and grade in the 5 percent or more free fatty acid group, indicating that at this level of free fatty acid, moisture could not be used as a predictor of grade. The effect of the high acid contents on grade obscured any relationship that may have existed between moisture and grade at this level.

Estimation Equations

Least squares estimation equations using moisture content as the independent variable were computed for each of the three free fatty acid groupings of the data. The resulting equations were:

(1) 2 percent or less free fatty acid: $Y = 108.28 - 0.788\,X$
(2) 2.1 to 4.9 percent free fatty acid: $Y = 112.77 - 1.587\,X$
(3) 5 percent or more free fatty acid: $Y = 84.10 - 0.812\,X$

Where $X =$ the moisture content of the lot of seed (percent) and $Y =$ the estimated grade (index).

The estimated grade for a lot of seed within any free fatty acid group can be derived by inserting the moisture content of the lot in the applicable estimation equation. It should be remembered, however, that the estimates would be valid only for lots of cottonseed with moisture contents within the range of the lots actually observed in the study. In addition, it must be remembered that grades estimated from the equation are only estimates and are subject to error. Grade can be estimated most precisely when the moisture content equals the mean moisture content of the sample, and the further the moisture content is from the mean, the less precise

TABLE 6.—Summary analysis of regression of grade on moisture content, by specified free fatty acid groupings

Items measured or computed	Number of observations 2% or less FFA[a] 718	 2.1 to 4.9% FFA 228	 5% or more FFA 156
Moisture content:			
Mean	9.3	12.33	12.48
Grade index:			
Mean	100.93	93.20	73.97
Correlation coefficient	0.4996**	0.2992**	0.1065
Coefficient of determination	0.2496	0.0896	0.0114
Regression coefficient	—0.7880**	—1.5870**	—0.8117
Total sum of squares	7,634.11	13,968.28	28,555.96
Reduction in S.S. due to regression[b]	1,905.82	1,250.86	324.18
Deviation from reg. S.S.	5,728.29	12,717.42	28,231.78
Variance of estimate S^2e	8.00	56.27	183.32
Standard error of estimate	2.83	7.50	13.54
Value of Y X = 0	+108.28	+112.77	+84.10

[a] FFA equals free fatty acid.

[b] S.S. equals sum of squares.

** Significant at .01 level.

the estimate will be.[16] In view of the small range of the data in each group, one could expect this type of error to be quite small.

Errors in Estimating Grade

The estimated grades of all lots of seed in each acid group were calculated using the appropriate equation developed above. The same procedure was followed to examine the errors in the estimated grades as was used to analyze the errors in prices paid for seed by ginners. The analysis was made for each of the three free fatty acid groups, for the 2 percent or less and the 2.1 to 4.9 percent groups combined, and for all groups combined.

The average actual grade[17] of cottonseed was 100.93, 93.20 and 73.97 for the 2 percent or less, 2.1 to 4.9 percent and 5 percent or more free fatty acid groups, respectively. The average estimated grades for the three groups were 100.93, 93.19 and 73.97, respectively (Table 7). The small differences in the means were not significant. This indicated that there was no bias on the average in the estimates of grades based on moisture content alone.

---

[16] Ostle, Bernard. Statistics in Research. Ames, Iowa, Iowa State College Press. 1954. For full discussion of error see pp. 148-151.

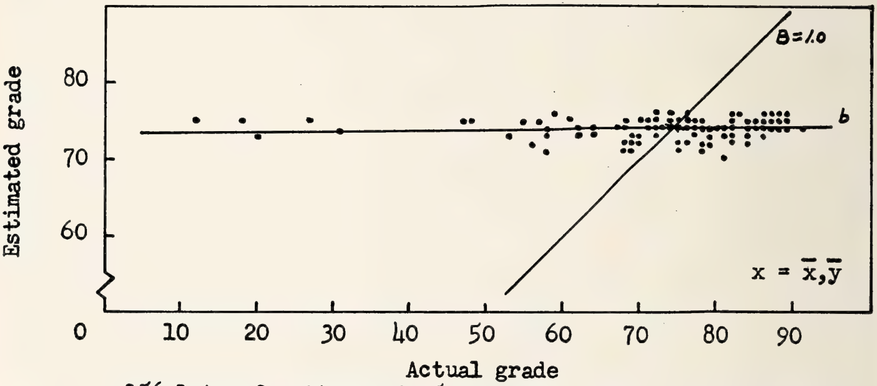
[17] Actual grade refers to the official grade analysis of each lot of cottonseed as obtained from the oil mill. Estimated grade refers to the grade calculated by use of the estimation equations developed in the study.

This does not mean, however, that there were no errors in the grade estimates, since it is possible that some grades may be overestimated while others are underestimated. To determine the extent of this type of error in the estimates, the linear regression of the estimated grades on the actual grades was computed. The regression coefficient was 0.2495, 0.0895 and 0.008 for the 2 percent or less, 2.1 to 4.9 percent and 5 percent or more free fatty acid groups. If the estimated and actual grades were identical for each group these coefficients would be 1.0. Tests revealed that the coefficients were all significantly different from 1.0, indicating that the relationship between the estimated and actual grades was not perfect. The linear regression lines ($B = 1.0$) pass through the means $\bar{x}, \bar{y}$, indicating that on the average the grades in each group were not biased (Figure 9). However, the computed regression lines are below the unbiased regression line when the grades are higher than the mean, indicating that on the average these grades are underestimated. The computed lines are above the unbiased line when the grades are below the mean, indicating that on the average these grades are overestimated. This type of error was smallest for the 2 percent or less acid group and largest for the 5 percent or more group. The scatter of the dots about the unbiased regression line indicates that the errors are quite large for the 5 percent group. The dots lie in a long narrow band across the graph and tend to be concentrated around the means $\bar{x}, \bar{y}$ on the right hand side of the graph. This indicates that errors in estimating the very low grades are quite large, but that the errors for the higher grades in this group would be considerably smaller. The scatter of dots about the unbiased lines is much smaller for the other two acid groups.

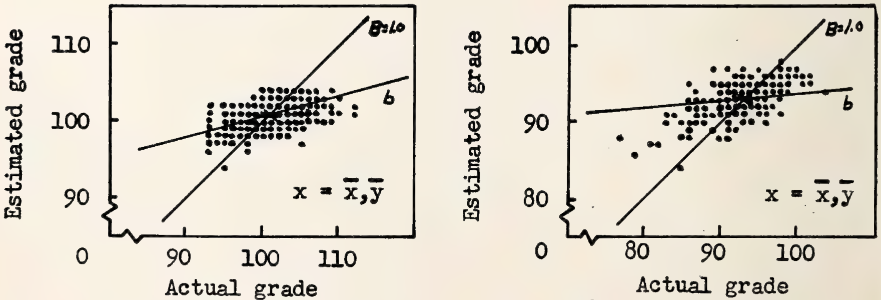
The standard deviation of the mean for the estimated grades was 1.63, 2.35 and 1.22 for the 2 percent or less, 2.1 to 4.9 percent and 5 percent or more free fatty acid groups, respectively, while the corresponding standard deviations for the actual grades were 3.26, 7.84 and 13.57. This indicates that approximately two-thirds of the estimated and actual grades would not vary above or below the mean by more than these amounts. The standard deviations of the means of the estimated grades were smaller for each group than the corresponding deviations for the actual grades, indicating that the estimated grades did not have as wide a range as the actual grades. This reflects a tendency of the estimated grades to cluster around the means.

The standard error of estimate was 4.46, 2.24 and 1.22 for the three groups, respectively. This indicates that the estimated grades would overestimate or underestimate the actual grade of approximately one-third of the lots of cottonseed by this amount, or more, if the observed regressions were used to correct the errors in the estimated grades.

Twenty-five percent of the variation in the estimated grades for the 2 percent group was linearly associated with the actual grades and 9 percent in the 2.1 to 4.9 percent group. Less than 1 percent of the variation in the estimated grades for the 5 percent or more groups was linearly associated with actual grades. Tests revealed a non-significant relationship between estimated and actual grades in the 5 percent or more acid group. This was to be expected in view of the non-significant relationship between moisture and grade in this group. The use of



156 lots of cottonseed, 5 percent or more free fatty acid



718 lots of cottonseed, 2 percent or less free fatty acid

228 lots of cottonseed, 2.1 to 4.9 percent free fatty acid

Figure 9.—Relationship between moisture-estimated grades and actual grades of cottonseed, by free fatty acid groups.

TABLE 7.—Summary of analysis of regression of moisture predicted grade on actual grade and grade errors, by free fatty acid groups[a]

Items measured or computed	Number of observations				
	2% or less FFA[b] 718	2.1 to 4.9% FFA 228	5% or more FFA 156	All observations 1,102	2% or less & 2.1 - 4.9% FFA combined 946
Predicted grade:					
Mean	100.93	93.19	73.97	95.51	99.06
Standard deviation	1.63	2.35	1.22	9.44	3.78
Actual grade:					
Mean	100.93	93.20	73.97	95.52	99.07
Standard deviation	3.26	7.84	13.57	11.47	5.81
Correlation coefficient	0.5002**	0.2995**	0.0283	0.8229	0.6502**
Coefficient of determination	0.2502	0.0897	0.0080	0.6772	0.4228
Regression coefficient	0.2495	0.0895	0.0080	0.6769	0.4226
Total sum of squares	1,899.89	1,247.99	231.11	98,025.55	13,495.49
Reduction in S.S. due to reg.[c]	475.25	111.93	1.85	66,384.27	5,705.53
Deviation from reg. S.S.	1,424.64	1,136.06	229.26	31,641.28	7,789.96
Variance of estimate S^2e	19.90	5.03	1.49	28.77	8.25
Standard error of estimate	4.46	2.24	1.22	5.36	2.87
Standard error of reg. coef.	0.051	0.019	0.007	0.014	0.016
(t) value for test Ho:b=1	14.70**	47.99**	137.39**	22.93**	35.93**
(t) value for test Ho:b=0	4.88**	4.72**	1.11	48.04**	26.30**
Mean difference (error)	0	—.01	0	—.01	—.01
Standard deviation	2.58	5.79	9.64	10.50	4.90
Standard error of mean	0.136	0.542	1.091	0.448	0.225
(t) value for test of hypothesis true mean difference = 0	—	0.018	—	.022	.044

[a] Error equals predicted grade minus actual grade.

[b] FFA equals free fatty acid.

[c] S.S. equals sum of squares.

**Significant at .01 level.

moisture alone to estimate the grade of cottonseed containing 5 percent or more free fatty acid can not be recommended on the basis of the results of this study. The analysis of grading errors for this group was included for comparative purposes only.

If grade estimates were to be made on the basis of moisture content, it was contemplated that the ginner would use each estimation equation in turn as the free fatty acid content increased from one level to the next succeedingly higher one. In order to ascertain the errors involved over the entire range of possible acid contents, the combined results of using all three estimation equations were considered.

The average estimated grade for all lots of cottonseed in the study was 95.51 while the average actual grade was 95.52 (Table 7). The small difference in the means was not significant, indicating that there was no bias on the average in the estimated grades.

The computed linear regression coefficient was 0.6769. Tests revealed that the regression coefficient was significantly different from 0 and 1.0, indicating a significant but imperfect relationship between the estimated and actual grades. The unbiased regression line ($B = 1.0$) passes through the means $\overline{x}, \overline{y}$, indicating that on the average the estimated grades were unbiased. However, the computed regression line lies below the unbiased line for grades higher than the mean and above for grades below the mean (Figure 10). This means that on the average the higher grades are underestimated and the lower grades are overestimated. Since the regression coefficient for all observations is considerably larger than for any one of the groups, the average error of overestimating and underestimating grades below and above the mean is not as great for all observations as it is for the individual groups. The difference in the standard deviation of the mean is also smaller for all observations. These relationships were expected in view of the fact that the unbiased regression line ($B = 1.0$) passes through the means $\overline{x}, \overline{y}$ of all three groups of data.

Approximately 68 percent of the variation in the estimated grades was linearly associated with the actual grades while 32 percent was unexplained. The standard error of estimate was 5.36. It is obvious from the graph that the standard error is not the same throughout the scatter diagram. The standard error for the combined groups is an average of the errors for each of the groups.

Although moisture content can not be used to estimate the grade of seed containing 5 percent or more free fatty acid, it is anticipated that it may be used to estimate grade for cottonseed containing less than 5 percent free fatty acid during seasons when higher acid contents do not occur. In view of this, the estimated grades for the 2 percent or less

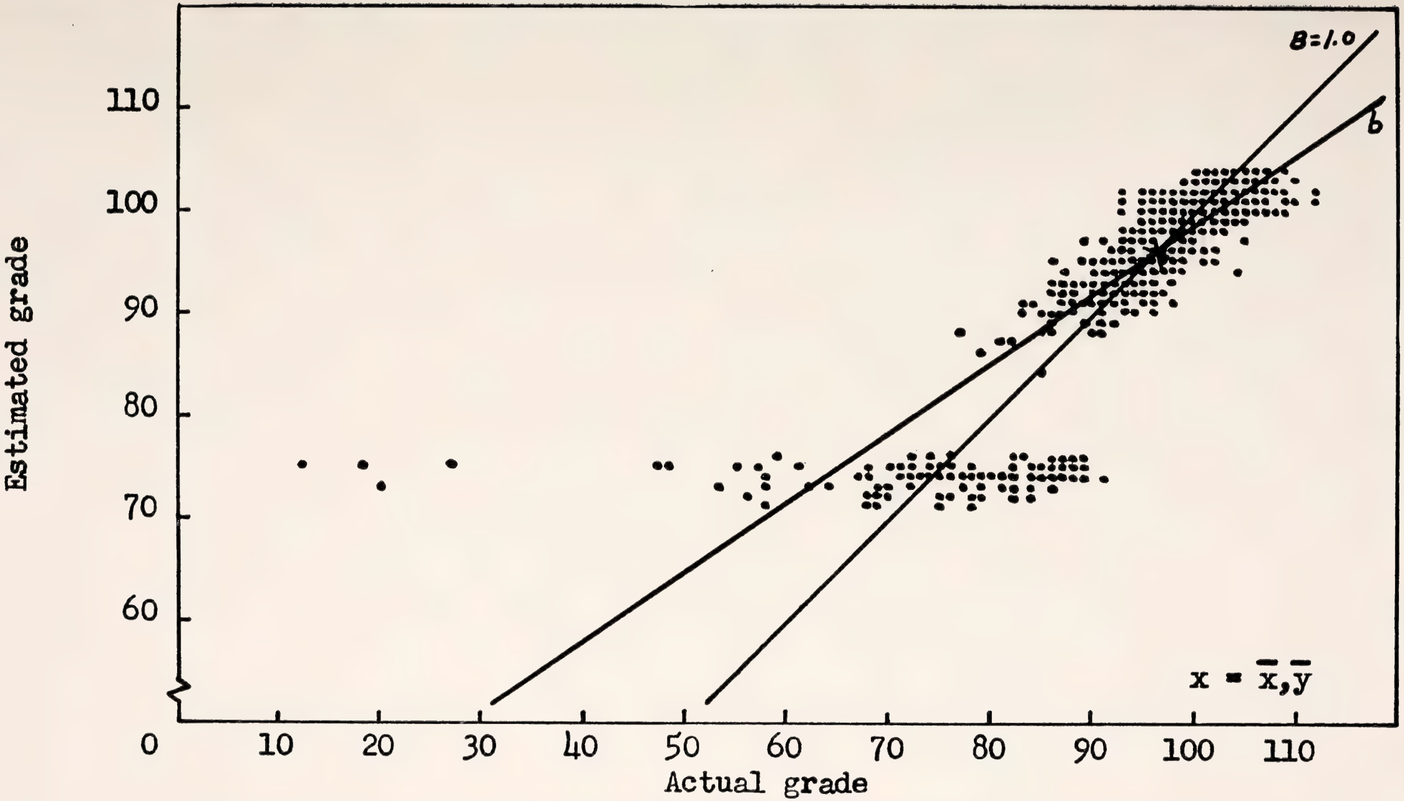


Figure 10.—Relationship between moisture-estimated grades and actual grades, 1,102 lots of cottonseed.

and 2.1 to 4.9 percent acid groups were combined for analysis. The results in general were similiar to those for all groups. The computed regression coefficient was reduced to 0.4226, the standard error of estimate to 2.87 and the coefficient of determination to 0.4226. On the average there was no bias in the grade estimates. However, those grades above the mean were underestimated while those below were overestimated. This type error was somewhat larger than for all observations combined because of the smaller regression coefficient.

Regression of Grade and Oil Content

Oil content is the second most important factor affecting cottonseed grades. Oil determinations by the USDA oil meter, however, are not as simply and quickly performed as are moisture determinations. Also, the original cost is somewhat higher for the oil meter than for the moisture meter and more skill is required for its operation. Grade estimates based on oil content alone, therefore, were considered to be second in importance from the standpoint of operational efficiency alone.

The same procedure was followed to analyze the relationship between oil content and cottonseed grades as was used for moisture. The data were divided into three groups on the basis of the free fatty acid content: (1) 2 percent or less; (2) 2.1 to 4.9 percent, and (3) 5 percent or more free fatty acid in the oil in the seed. Single variable linear regressions of grade on oil content were computed for each acid grouping. All of the regression coefficients showed a positive relation-

TABLE 8.—Summary analysis of regression of grade on oil content, by specified free fatty acid groupings

Items measured or Computed	Number of observations		
	2% or less FFA[a] 718	2.1 to 4.9% FFA 228	5% or more FFA 156
Oil content :			
Mean	18.26	18.35	18.24
Grade index:			
Mean	100.93	93.20	73.97
Correlation coefficient	0.8415**	0.2550**	0.3801**
Coefficient of determination	0.7082	0.0651	0.1445
Regression coefficient	+3.6860**	+2.9856**	+7.1319**
Total sum of squares	7,634.11	13,968.28	28,555.96
Reduction in S.S. due to regression[b]	5,406.50	909.92	4,127.07
Deviation from reg. S.S.	2,227.61	13,058.36	24,428.89
Variance of estimate S^2e	3.11	57.78	158.63
Standard error of estimate	1.76	7.60	12.60
Value of Y X = 0	+33.62	+38.41	−56.12

[a] FFA equals free fatty acid.
[b] S.S. equals sum of squares.
**Significant at .01 level.

ship between the oil content of the seed and cottonseed grade. The standard error of estimate was 1.76 compared to 2.81 for moisture in the less than 2 percent acid group; 7.60 compared to 7.50 in the 2.1 to 4.9 percent acid group, and 12.60 compared to 13.54 in the 5 percent or more acid group (Table 8). Approximately 71 percent of the variation in oil contents was associated with variations in the grades of the seed in the 2 percent or less acid group, while only 7 and 14 percent was so associated in the 2.1 to 4.9 percent and 5 percent or more acid groups, respectively. All of the regressions were found to be significant at the 1 percent level.

Estimation Equations

Least squares estimation equations using the oil content as the independent variable were computed for each of the three acid groups. The resulting equations were:

(1) 2 percent or less free fatty acid: $Y = 33.62 + 3.686\ X$
(2) 2.1 to 4.9 percent free fatty acid: $Y = 38.41 + 2.986\ X$
(3) 5 percent or more free fatty acid: $Y = -56.12 + 7.132\ X$

Where $X =$ the oil content of the lot of seed (percent) and $Y =$ the estimated grade (index).

The estimated grade for a lot of cottonseed within any free fatty acid group can be derived by inserting the oil content of the lot in the applicable estimation equation. These estimates are subject to the same limitations as indicated for those based on moisture content.

Errors in Estimating Grade

The estimation equations developed above were used to estimate the grade of all lots of seed in the appropriate acid groups. The same procedures were followed to analyze the errors of the grade estimates as were used for moisture.

The average actual grade of cottonseed was the same for each acid group as that in the moisture analysis. The average estimated grades for the three groups were 100.92, 93.22 and 73.98 for the 2 percent or less, 2.1 to 4.9 percent and 5 percent or more acid groups, respectively (Table 9). The small differences in the means were not significant, indicating that there was no bias on the average in the estimates of grade based on oil content alone. The computed regression coefficient was 0.7218, 0.0646 and 0.1443 for the three acid groups, respectively. The coefficients for the 2 percent or less and 5 percent or more groups were considerably higher than the corresponding coefficients for the moisture estimated grades. All of the coefficients were found to be significantly different from 1.0, indicating that the relationship between the estimated and actual grades was not perfect. Like the moisture data, the linear regression lines ($B = 1.0$) pass through

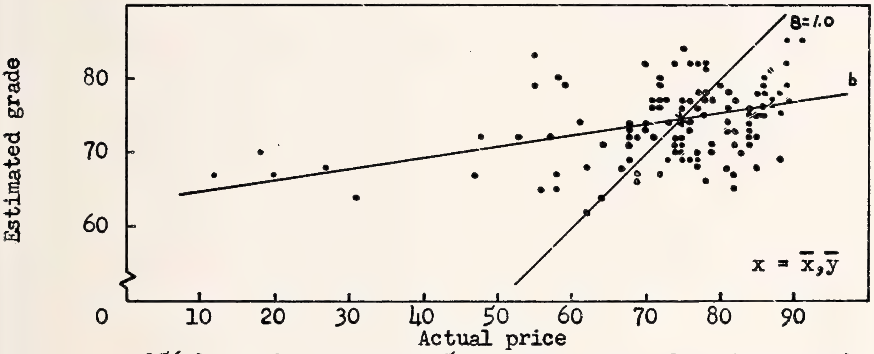
TABLE 9.—Summary of analysis of regression of oil predicted grade on actual grade and grade errors, by free fatty acid groups[a]

Items measured or computed	Number of observations				
	2% or less FFA[b] 718	2.1 to 4.9% FFA 228	5% or more FFA 156	All observations 1,102	2% or less & 2.1 - 4.9% FFA combined 946
Predicted grade:					
Mean	100.92	93.22	73.98	95.49	99.06
Standard deviation	2.80	1.97	4.92	10.02	4.21
Actual grade:					
Mean	100.93	93.20	73.97	95.52	99.07
Standard deviation	3.26	7.84	13.57	11.47	5.81
Correlation coefficient	0.8413**	0.2569**	0.3977**	0.8537**	0.7223**
Coefficient of determination	0.7078	0.0660	0.1582	0.7288	0.5217
Regression coefficient	0.7218	0.0646	0.1443	0.7456	0.5231
Total sum of squares	5,618.56	883.03	3,757.49	110,518.81	16,755.54
Reduction in S.S. due to reg.[c]	3,976.94	58.26	594.29	80,543.40	8,741.30
Deviation from reg. S.S.	1,641.62	824.77	3,163.20	29,975.41	8,014.24
Variance of estimate S^2e	2.29	3.65	20.54	27.25	8.49
Standard error of estimate	1.51	1.91	4.53	5.22	2.91
Standard error of reg. coef.	0.017	0.016	0.027	0.014	0.016
(t) value for test Ho:b=1	16.08**	57.74**	31.93**	18.57**	29.26**
(t) value for test Ho:b=0	41.72**	3.99**	5.38**	54.42**	32.09**
Mean difference (error)	—.01	+.02	+.01	—.03	—.01
Standard deviation	3.04	5.72	10.21	10.77	5.08
Standard error of mean	0.160	0.536	1.156	0.459	0.233
(t) value for test of hypothesis true mean difference = 0	0.062	0.037	0.008	0.065	0.043

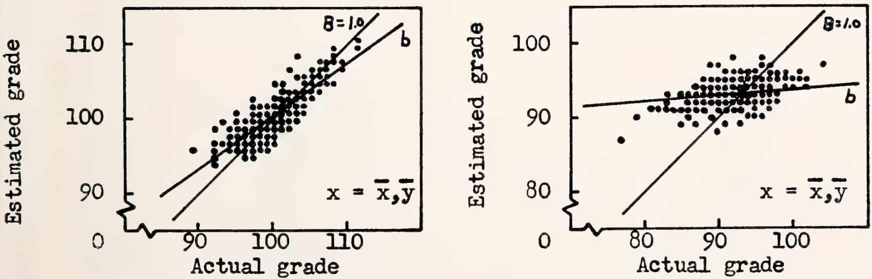
[a] Error equals predicted grade minus actual grade.
[b] FFA equals free fatty acid.
[c] S.S. equals sum of squares.
**Significant at .01 level.

the means $\bar{x}$, $\bar{y}$, indicating that on the average the lower grades in each group are overestimated and the higher grades are underestimated (Figure 11). This type error was considerably smaller in the 2 percent or less acid group, slightly higher in the 2.1 to 4.9 percent group and considerably smaller in the 5 percent or more acid group, for the oil estimated grades as compared with the moisture estimated grades. The scatter of dots about the unbiased regression line was considerably smaller in the 2 percent or less acid group than in the other two groups. It was also smaller than for the corresponding group for the moisture grades, indicating a smaller error in the grade estimates.

The standard deviation of the mean was smaller for the estimated grades than for the actual grades in each group, with the smallest difference being found in the 2 percent or less acid group. The estimated grades showed more of a tendency to cluster around the mean than did the actual grades.



156 lots of cottonseed, 5 percent or more free fatty acid



718 lots of cottonseed, 2 percent or less free fatty acid

228 lots of cottonseed, 2.1 to 4.9 percent free fatty acid

Figure 11.—Relationship between oil-estimated grades and actual grades of cottonseed, by free fatty acid groups.

The standard error of estimate was 1.51, 1.91 and 4.53 for the three acid groups, respectively. Each standard error of estimate was less than that for the moisture analysis except in the 5 percent or more acid group.

Approximately 71 percent of the variation in the estimated grades was linearly associated with the actual grades in the 2 percent or less group, 7 percent in the 2.1 to 4.9 acid group and 16 percent in the 5 percent or more acid group. These percentages were considerably higher in the 2 percent and less and the 5 percent or more acid groups than they were for the corresponding groups for moisture grade estimates.

The average estimated grade for the combined groups was 95.49 while the average actual grade was 95.52 (Table 9). The small difference in the means was not significant, indicating that there was no bias on the average in the estimated grades for all lots of seed.

The computed regression coefficient for the combined groups was 0.7456. Tests revealed that the regression coefficient was significantly different from 0 and 1.0. This indicated a significant but imperfect relationship between the oil estimated grades and actual grades. The unbiased regression line (B = 1.0) passes through the means $\bar{x}$, $\bar{y}$, indicating that on the average the estimated grades were unbiased. However, the computed line lies below the unbiased line for grades higher than the mean and above for grades below the mean (Figure 12). This means that on the average the oil estimated grades underestimate the higher grades and overestimate the lower grades. This type error was smaller for the oil estimated grades than for the moisture estimated grades and was smaller than that found in any of the individual acid groups.

Approximately 73 percent of the variation in the estimated grades was linearly associated with the actual grades compared to 68 percent for the moisture estimated grades. The standard error of estimate was 5.22.

Multiple Regression of Grade, Oil Content and Moisture Content

In order to make use of both the oil and moisture content of seed in estimating grade, the ginner would have to purchase both USDA meters and perform two tests on each lot of seed purchased. Not only would the cost of both meters be larger than for any single one, but also the time and skill required to make the two tests would be increased beyond that required to perform either one alone. It may be anticipated that the accuracy of the grade estimates using both factors will be greater than that obtained by using either one alone. However, unless this increased

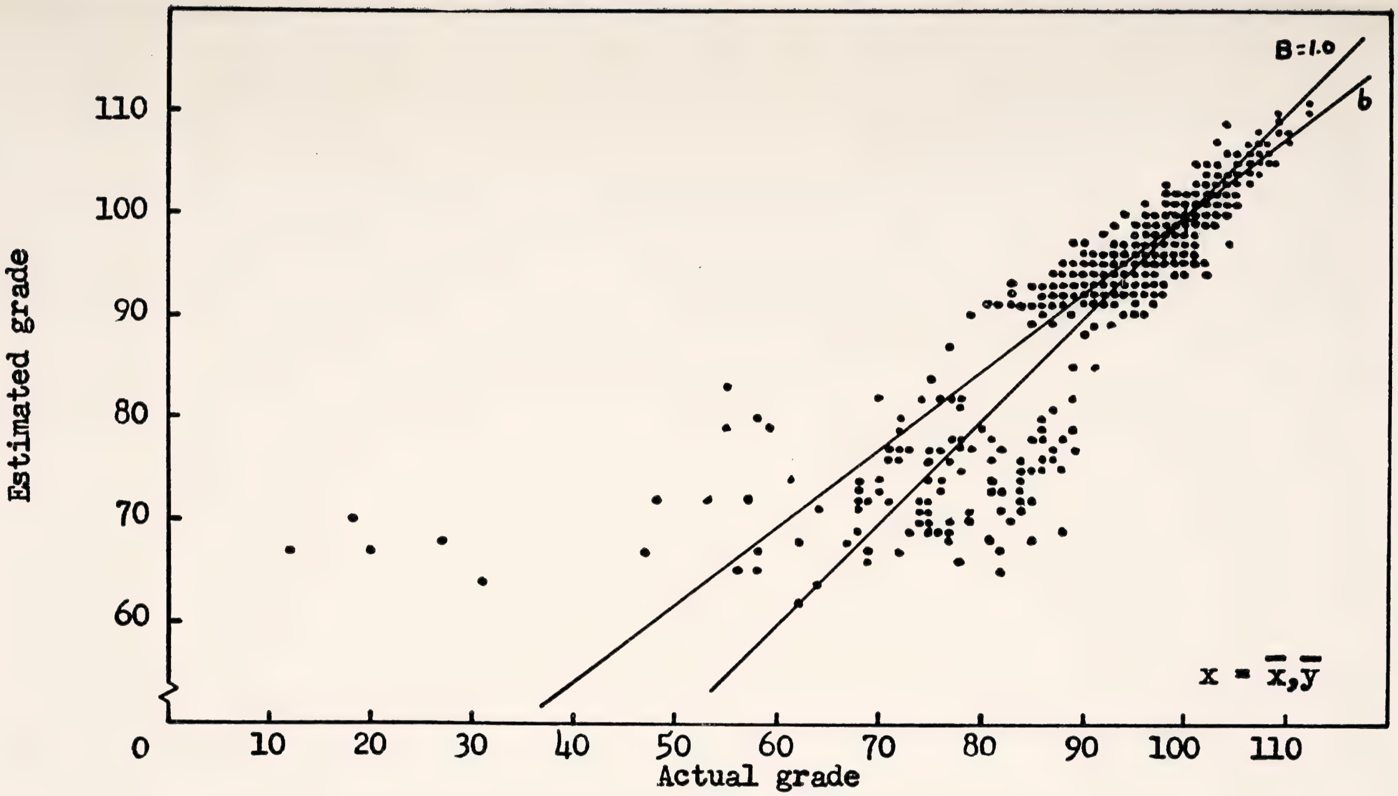


Figure 12.—Relationship between oil-estimated grades and actual grades, 1,102 lots of cottonseed.

efficiency more than offsets the decrease in operational efficiency occasioned by the use of both, it would not be considered practical.

The same procedure was followed to analyze the relationship between oil, moisture and grade as was used in the single variable analysis. The data were divided into three groups on the basis of free fatty acid content, and multiple linear regressions of grade on oil and moisture content were computed for each acid grouping. Snedecor's[18] direct method of computation for three varieties was used for the analysis. The standard error of estimate was 1.34, 7.41 and 12.62 for the three acid groups, respectively (Table 10). The coefficient of determination was 0.833, 0.115 and 0.147 for the three acid groups, all of which were higher than the corresponding coefficients for the oil or moisture variables alone. The partial regression coefficients for oil content were positive, while those for moisture were negative, with the exception of the 5 percent or more acid group. This means that grade increased with each unit increase in oil content and decreased with each unit increase in moisture content, except in the high acid group, where grade increased as moisture increased. All of the regressions were found to be significant at the 1 percent level.

TABLE 10.—Summary analysis of multiple regression of grade on oil and moisture content, by specified free fatty acid groupings

Items measured or computed	Number of observations		
	2% or less FFA[a] 718	2.1 to 4.9% FFA 228	5% or more FFA 156
Moisture content:			
Mean	18.26	18.35	18.24
Oil content:			
Mean	9.33	12.33	12.48
Grade index:			
Mean	100.93	93.20	73.97
Correlation coefficient	0.9127**	0.3398**	0.3833**
Coefficient of determination	0.8330	0.1155	0.1469
Partial reg. coef.-oil	+3.4019	+2.0093	+7.4803
Partial reg. coef.-moisture	—0.5665	—1.2696	+0.4686
Total sum of square	7,634.11	13,968.28	28,555.96
Reduction S.S. due to reg.[b]	6,359.44	1,612.87	4,194.63
Deviation from reg. S.S.	1,274.67	12,355.41	24,361.33
Variance of estimate S^2e	1.78	54.91	159.22
Standard error of estimate	1.34	7.41	12.62
Value of Y X = 0	+44.10	+71.99	—68.32

[a] FFA equals free fatty acid.
[b] S.S. equals sum of squares.
**Significant at .01 level.

---

[18] Snedecor, George W. Statistical Methods. Fourth Edition. Ames, Iowa, Iowa State College Press. 1946. pp. 364-369.

Estimation Equations

Multiple least squares estimation equations using the oil and moisture content as independent variables were calculated for each of the three acid groups. The resulting equations were:

(1) 2 percent or less free fatty acid: $Y = 44.10 + 3.402\ X_1 - 0.567\ X_2$
(2) 2.1 to 4.9 percent free fratty acid: $Y = 71.99 + 2.009\ X_1 - 1.270\ X_2$
(3) 5 percent or more free fatty acid: $Y = -68.32 + 7.480\ X_1 + 0.469\ X_2$

Where $X_1 =$ the oil content of the lot of seed (percent), and $X_2 =$ the moisture content of the lot of seed (percent) and $Y =$ the estimated grade (index).

The estimated grade for a lot of cottonseed within any free fatty acid group may be derived by inserting the oil and moisture contents of the lot in the applicable estimation equation. The estimated grades obtained are subject to similar limitations as those indicated for the single variable equation estimates.

Errors in Estimating Grade

The three equations devloped above were used to estimate the grade of all lots of seed in the appropriate acid groups. The average estimated grades for the three acid groups were 100.93, 93.20 and 73.98, while the average actual grades were 100.93, 93.20 and 73.97 (Table 11). There was no difference in the means for the first two groups. The +.01 difference for the 5 percent or more free fatty acid group was not found to be significant. This means that there was no bias on the average in the grade estimates based on the oil and moisture content of the seed. The computed regression coefficients for the three acid groups were 0.8325, 0.1155 and 0.1466, respectively. All of the regression coefficients were found to differ significantly from 1.0, indicating an imperfect relationship between the variables. The unbiased regression lines ($B = 1.0$) pass through the means x, y, indicating that on the average the lower grades in each group are overestimated while the higher grades are underestimated (Figure 13). This type error was very small for the 2 percent or less acid group and was smaller for all groups than the corresponding error for either moisture or oil alone. The scatter of the dots about the unbiased regression line was also smaller, indicating a smaller grade error.

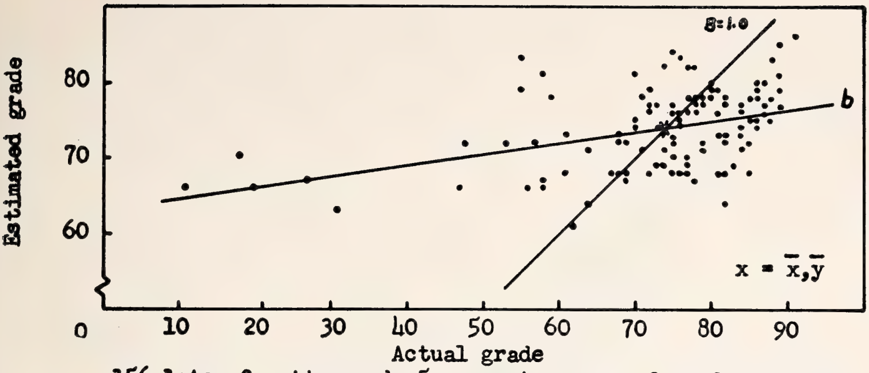
Approximately 83 percent of the variation in the estimated grades was linearly associated with the actual grades in the low free fatty acid group, 12 percent in the 2.1 to 4.9 acid group and 16 percent in the 5 percent or more free fatty acid group. The standard error of estimate was 1.22, 2.52 and 4.53 for the three groups, respectively.

The average estimated grade for the combined groups was 95.51 while the average actual grade was 95.52. The small difference in the

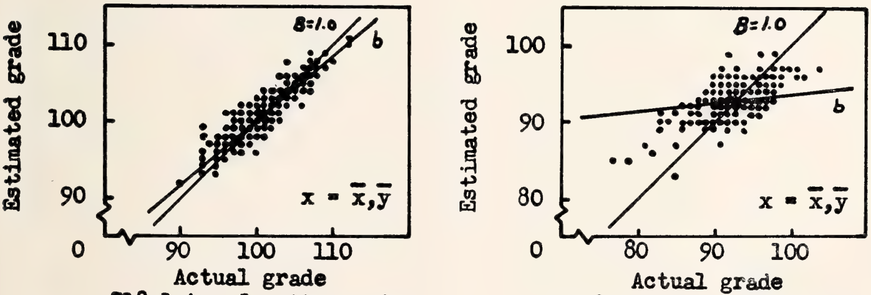
TABLE 11.—Summary of analysis of regression of oil-moisture predicted grade on actual grade and grade errors, by free fatty acid groups[a]

Items measured or computed	Number of observations				
	2% or less FFA[b] 718	2.1 to 4.9% FFA 228	5% or more FFA 156	All observations 1,102	2% or less & 2.1 - 4.9% FFA combined 946
Predicted grade:					
Mean	100.93	93.20	73.98	95.51	99.06
Standard deviation	2.98	2.67	4.93	9.83	4.40
Actual grade:					
Mean	100.93	93.20	73.97	95.52	99.07
Standard deviation	3.26	7.84	13.57	11.47	5.81
Correlation coefficient	0.9119**	0.3396**	0.4034**	0.8605**	0.7569**
Coefficient of determination	0.8316	0.1153	0.1627	0.7405	0.5729
Regression coefficient	0.8325	0.1155	0.1466	0.7371	0.5730
Total sum of squares	6,363.29	1,617.75	3,772.10	106,304.58	18,306.84
Reduction in S.S. due to reg.[c]	5,291.44	186.45	613.55	78,718.28	10,487.82
Deviation from reg. S.S.	1,071.85	1,431.30	3,158.55	27,586.30	7,819.02
Variance of estimate S^2e	1.50	6.33	20.51	25.08	8.28
Standard error of estimate	1.22	2.52	4.53	5.01	2.88
Standard error of reg. coef.	0.014	0.021	0.027	0.013	0.016
(t) value for test Ho:b=1	11.96**	41.52**	31.84**	19.92**	26.52**
(t) value for test Ho:b=0	59.46**	5.42**	5.47**	55.84**	35.59**
Mean difference (error)	0	0	+.01	—.01	—.01
Standard deviation	3.12	5.86	10.21	10.68	5.16
Standard error of mean	0.165	0.549	1.156	0.455	0.237
(t) value for test of hypothesis true mean difference = 0	——	——	0.008	0.022	0.042

[a] Error equals predicted grade minus actual grade.
[b] FFA equals free fatty acid.
[c] S.S. equals sum of squares.
**Significant at .01 level



156 lots of cottonseed, 5 percent or more free fatty acid



718 lots of cottonseed,
2 percent or less free
fatty acid

228 lots of cottonseed,
2.1 to 4.9 percent free
fatty acid

Figure 13.—Relationship between oil-moisture-estimated grades and actual grades of cottonseed, by free fatty acid groups.

means was not significant, indicating no bias on the average in the estimated grades.

The computed regression coefficient for the combined groups was 0.7371. Tests revealed that the regression coefficient was significantly different from 0 and 1.0. The unbiased regression line (B = 1.0) passes through the means $\bar{x}$, $\bar{y}$ on the computed line. The computed line lies below the unbiased line for grades higher than the mean and above the line for grades lower than the mean (Figure 14). This means that on the average the oil-moisture estimated grades also underestimate

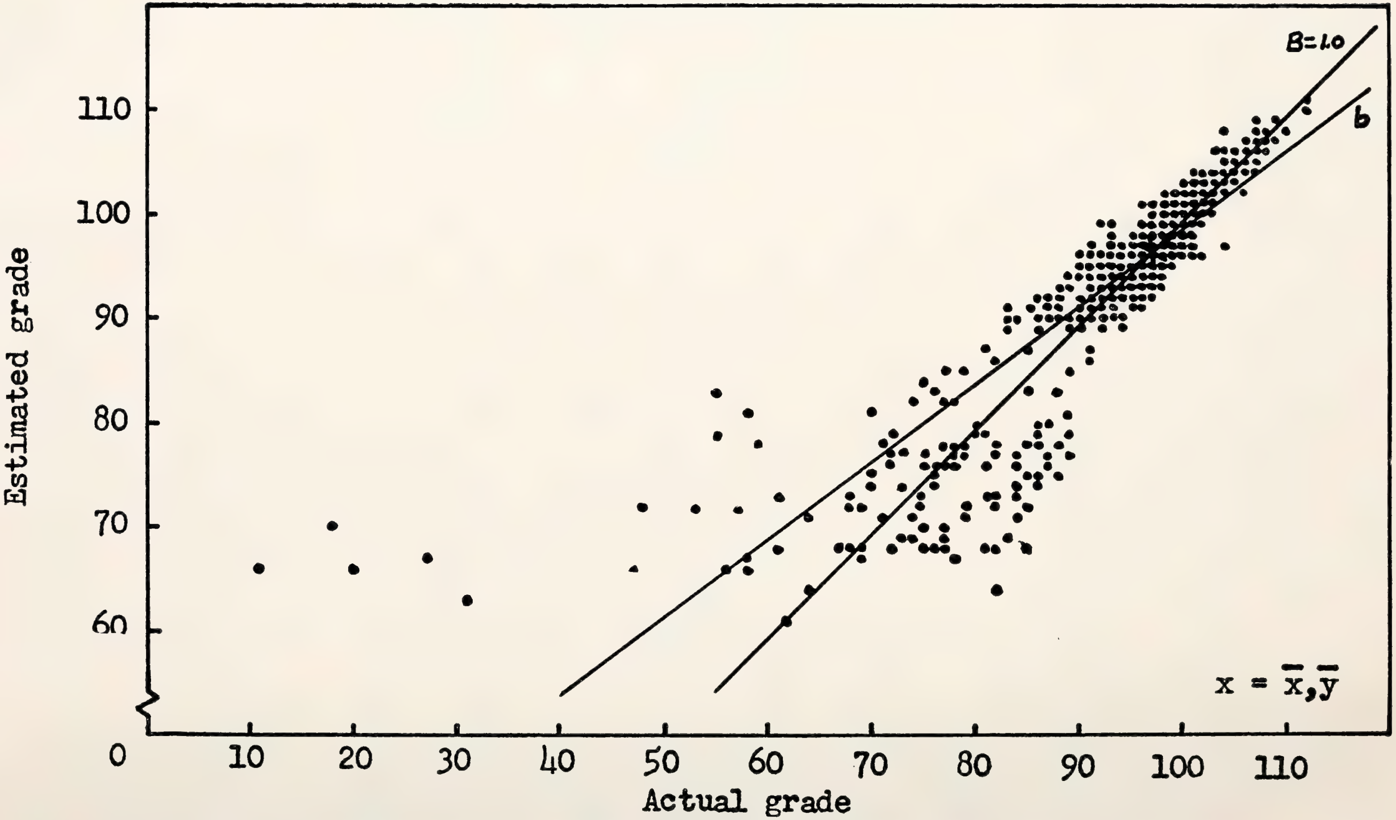


Figure 14.—Relationship between oil-moisture-estimated grades and actual grades, 1,102 lots of cottonseed.

the higher and overestimate the lower grades of cottonseed. The over and underestimates were not as great, however, as those for moisture and were only slightly larger than those for oil estimated grades.

Approximately 74 percent of the variation in the estimated grades were linearly associated with the actual grades. The standard error of estimate for the combined groups was 5.01.

This analysis has been based upon data pertaining to lots of cottonseed as shipped by the ginner to the oil mill. It is logical to assume, however, that the same accuracy of the grade estimates, using the various alternative methods, could be expected if they were applied to individual bale lots of seed as purchased by the ginner. The estimated grade of each individual bale lot of seed may be obtained through the use of the appropriate prediction equation for each alternative. If a random sample of seed is obtained for the moisture and oil determinations on each individual bale lot and for the shipment, then the oil and moisture content for the shipment should equal the average of all the individual bale lots making up the shipment. Thus, the use of the estimating equations will not only allow the ginner to estimate the grade of each individual lot of seed, but it will also enable him to estimate the average grade of each shipment to the mill.

The regression equations presented in this section may be thought of as theoretical grade standards for grading cottonseed at the gin. They are in a form that can be used in grading operations at the gin through the use of the appropriate USDA meters. If the use of the meters is practical in terms of operational efficiency considerations, the equations may be used to sort cottonseed at the gin according to its quality.

PRICES PREDICTED ON THE BASIS OF ESTIMATED GRADES

The three alternative methods of estimating cottonseed grades may be directly compared to ascertain the efficiency of each in comparison with the others. However, since no data were available on the grades as presently estimated by ginners, the accuracy of the alternative grade estimates as compared with the system now in use could not be directly determined. The only way in which a comparison may be made is in terms of pricing accuracy. In order to do this, all of the estimated grades for each alternative method were converted into the form of predicted prices. This was accomplished by multiplying the estimated grade by the applicable oil mill base price for each lot of cottonseed. This method of predicting prices is based upon the assumption that the oil mill base price is known with certainty and the ginner is informed in advance of any changes in the base price. This is a logical assumption in view of the competition among mills for seed and the close contact between oil mills and their gin customers throughout the ginning season. Conversations with ginners during the collection of field data for the study confirmed this relationship. Ginners reported that the oil mills generally notified them of changes in the base price either by phone or by letter before putting the changes into effect.

In the analysis of pricing errors in the present system, a similar assumption was made and the evaluations of pricing errors were made on this basis. To the extent that this assumption may be in error, part of the improvement in pricing accuracy through the use of the three alternative methods of estimating grade may be because of the greater accuracy in reflecting base price changes. This would in no way detract from the importance of any overall reduction in pricing errors that may be obtained by using the proposed alternatives. It would only be a matter of concern in determining more precisely the amount of the reduction in errors that may be the result of each cause.

Another basic assumption made in the analysis of pricing errors for the present system was that of constant margins. This assumption is more likely to be subject to some error. It is logical to assume that the individual ginner will attempt to maintain a constant margin on all seed transactions and that competition among gins within any area would tend to equalize these margins among gins. However, differences in margins among gins may occur because of differences in trade practices and to the extent that they do, pricing errors evaluated on the basis of constant margins would be affected. This factor would not detract from the overall analysis of pricing errors between the present and suggested alternative methods. It would be of importance only as a factor affecting prices paid by ginners under the present system.

All of the proposed alternative pricing systems are, in effect, methods of predicting the price that will be received from the oil mill for each lot of seed. The accuracy of the alternative systems may be evaluated on the basis of how closely the predicted prices[19] are associated with the actual prices received. In the practical application of the alternative systems the ginner may deduct any size margin he may desire without affecting the accuracy of the predicted prices in reflecting variations in the actual prices received.

Price Prediction Equations

The price received for cottonseed from the oil mill is determined by multiplying the grade (grade index) by the current oil mill base price per ton. The oil mill base price is quoted for basis grade seed (grade index 100). Grades above 100 multiplied by the base price result in premiums above the base price and grades below 100 result in discounts below the base price. This type of pricing system may be described by a pricing model of the form $P = G\ (B)$, where P equals price received, G equals grade index and B equals the base price for basis grade seed. Corresponding pricing models were developed to convert the estimated grades, computed with the three alternative estimation equations, into predicted prices.

---

[19] "Predicted prices" refer to prices calculated on the basis of theoretical grade standards developed in the study. They are predictions of the prices that will be received from the oil mill when the seed are sold. "Actual prices" received refer to the prices the ginner received when the seed were sold to the oil mill.

Three pricing equations were formulated for each alternative, representing the three free fatty acid groupings under each. A total of nine prediction equations were formulated for use in the analysis. For practical application of the alternative systems, the predicted prices may be calculated for all possible observations applicable to each equation, at various specified base prices. By placing the data in tabular form the user would be able to read directly from the table the predicted price for any designated combination of factors involved. It must be remembered, however, that any predictions based on data outside the range of the observations in the study would be very risky and not recommended.

Accuracy of Predicted Prices

The same procedures were used in the analysis of pricing errors for the predicted prices as were used in the analysis of errors in the prices paid and in the analysis of errors in estimated grades. Pricing errors for each alternative system were evaluated as well as those for the three free fatty acid groups under each. No adjustments were made for margins since the predicted and actual prices received are directly comparable in this analysis.

Moisture-Grade Predicted Prices

The three price prediction equations computed on the basis of the moisture-grade estimates were as follows:

(1) For seed containing 2 percent or less free fatty acid:

$$P' = 108.28 - 0.788\ X\ (C)$$

(2) For seed containing from 2.1 to 4.9 percent free fatty acid:

$$P' = 112.77 - 1.587\ X\ (C)$$

(3) For seed containing 5 percent or more free fatty acid:

$$P' = 84.10 - 0.812\ X\ (C)$$

In each equation X is the moisture content, C is the oil mill base price for basis grade seed (grade = 100) and P' is the predicted price.

The predicted price for any lot of seed may be calculated by inserting the applicable moisture content and oil mill base price in the appropriate acid content equation. The same limitations will apply to the predicted prices as were applicable to the estimated grades.

The predicted prices of all lots of seed in each acid group were computed by use of the above equations. These data were then subjected to pricing error analysis.

The average predicted price based on the moisture-grade estimates was $60.11, $53.50 and $42.85 for the 2 percent or less, 2.1 to 4.9 percent and 5 percent or more free fatty acid groups, respectively. The average price received was $60.16, $53.22 and $44.34, respectively. The differences of —.05 and +.28 for the 2 percent or less and 2.1 to 4.9 percent acid groups were not significant. The difference of —1.49 for the 5 percent or more acid group was highly significant (Table 12). This indicates that on the average there was no bias in the predicted prices for the two lower acid groups, while there was a significant downward bias in the five percent or more group.[20] This means that in normal seasons, when free fatty acid contents would not be expected to exceed 4.9 percent, predicted prices based on moisture-grade estimates would, on the average, equal actual prices received. In seasons during which the free fatty acid content of some lots of seed exceed 5 percent, the predicted prices for this group would, on the average, underestimate the actual prices received for the seed.

The computed linear regression coefficients for the three acid groups, were 0.8670, 0.7546 and 0.0770, respectively. Tests revealed that all of the coefficients were significantly different from 0 and 1.0, indicating a significant but imperfect relationship between predicted prices and actual prices received. The unbiased regression line ($B = 1.0$) passes through the means $\overline{x}$, $\overline{y}$ of both the 2 percent and less and the 2.1 to 4.9 percent acid groups (Figures 15 and 16). However, since the computed regression line lies below the unbiased line for observations greater than the mean and above for those less than the mean, it can be seen that on the average the predicted prices underestimate the actual prices received for values greater than the mean and overestimate those below the mean. This type error was smaller for the 2 percent or less group than for the 2.1 to 4.9 percent acid group, as indicated by the greater slope of the computed regression line for the 2 percent or less group. The scatter of dots above the unbiased regression line indicates that pricing errors have been reduced considerably in comparison with

---

[20] Normally this would not be true. In rechecking the data to ascertain why this relationship existed in the 5 percent or more acid group, it was found that when the grade of the seed was very low, the oil mill, in some cases, paid the ginner a price in excess of that indicated by the base price and grade. In other words, in some cases, the mill did not discount the shipment by the full amount indicated by the grade of the seed. If the price received data were adjusted in these cases to reflect the full discount, it is expected that the difference between the average price received and average predicted price would not be significant.

TABLE 12.—Sumary analysis of regression of moisture predicted prices on prices received for cottonseed by ginners and price errors, by free fatty acid groups[a]

Items measured or computed	Number of observations			
	2% or less FFA[b] 718	2.1 to 4.9% FFA 228	5% or more FFA 156	All observations 1,102
Predicted price:				
Mean	60.11	53.50	42.85	56.28
Standard deviation	5.80	3.55	1.82	7.86
Price received by ginner:				
Mean	60.16	53.22	44.34	56.48
Standard deviation	6.43	4.01	5.97	8.20
Correlation coefficient	0.9615**	0.8535**	0.2516**	0.9386**
Coefficient of determination	0.9244	0.7284	0.0633	0.8809
Regression coefficient	0.86698	0.75463	0.0770	0.9000
Total sum of squares	24,138.38	2,859.49	516.20	68,039.61
Reduction in S.S. due to reg.[c]	22,314.42	2,082.90	32.70	59,936.44
Deviations from reg. S.S.	1,823.96	776.59	483.50	8,103.17
Variance of estimate S^2e	2.55	3.44	3.14	7.37
Standard error of estimate	1.60	1.85	1.77	2.71
Standard error of reg coef.	0.009	0.031	0.239	0.010
(t) value for test Ho:b=1	14.37**	8.01**	38.70**	10.00**
(t) value for test Ho:b=0	93.63**	24.63**	3.23**	90.12**
Mean difference (error)	—.05	+.28	—1.49	—.20
Standard deviation	6.13	3.79	4.41	6.23
Standard error of mean	0.154	0.355	0.499	0.342
(t) value for test of hypothesis true mean difference = 0	0.324	0.789	2.98**	0.058

[a] Error equals predicted price minus actual price.

[b] FFA equals free fatty acid.

[c] S.S. equals sum of squares.

**Significant at .01 level.

those found in the present system. The pricing errors for the 2 percent or less group are quite small.

The unbiased regression line cuts the computed line below and to the left of the means $\bar{x}, \bar{y}$ for the 5 percent or more group, again indicating that on the average predicted prices underestimated the actual prices received. The computed line lies below the unbiased line to the right of the intersection point and below it to the left of this point. This means that on the average the predicted prices underestimate the higher valued seed and overestimate the lower valued seed.

Approximately 92 percent of the variation in the predicted prices was linearly associated with the actual prices received in the 2 percent or less acid group as compared with 73 and 6 percent for the two higher acid groups, respectively. The standard deviation of the mean for the predicted prices was 5.80, 3.55 and 1.82 for the three groups while the standard deviation of the mean for the actual prices received was 6.43,

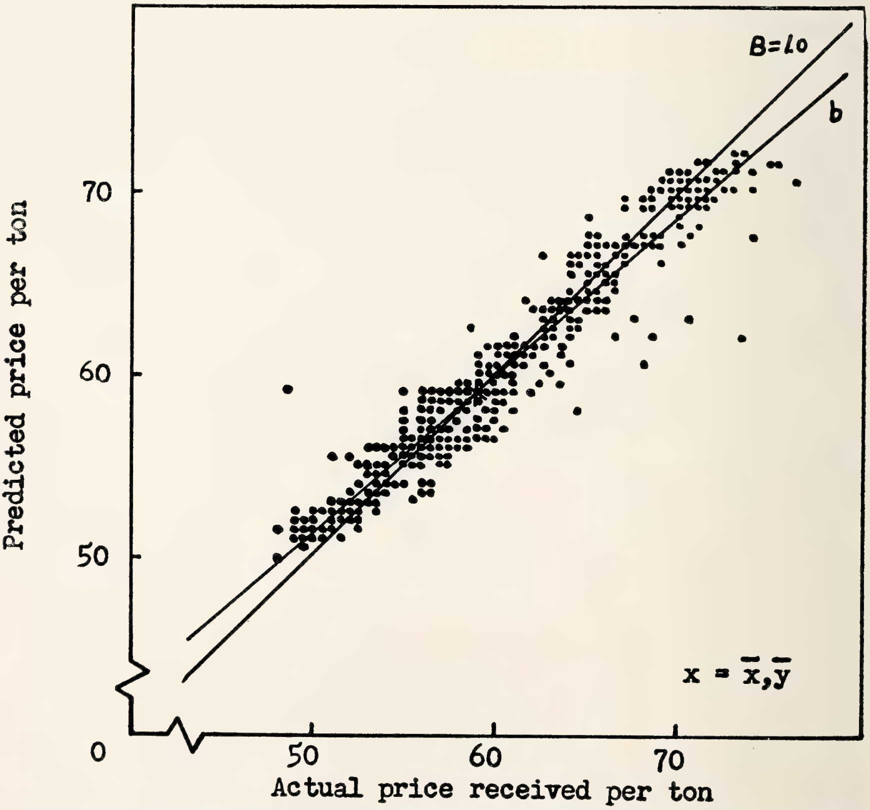
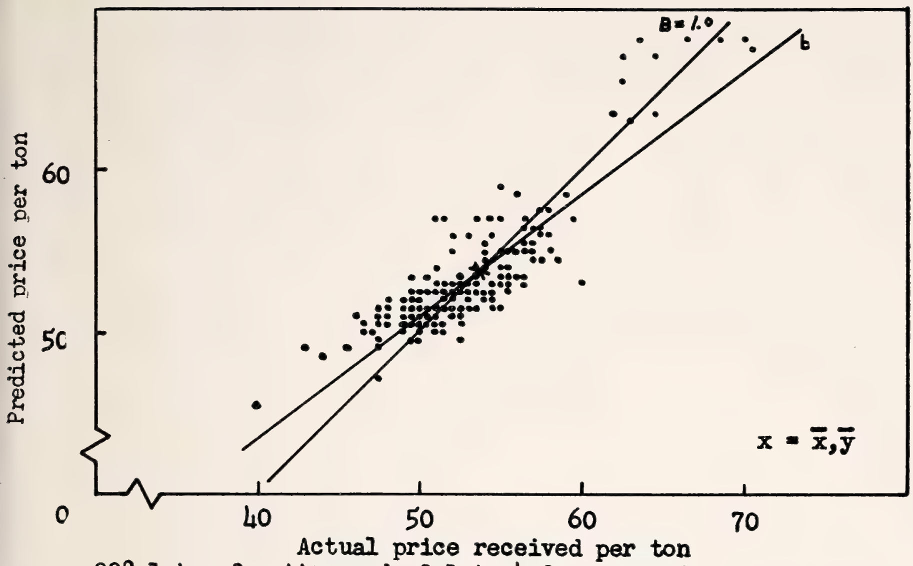
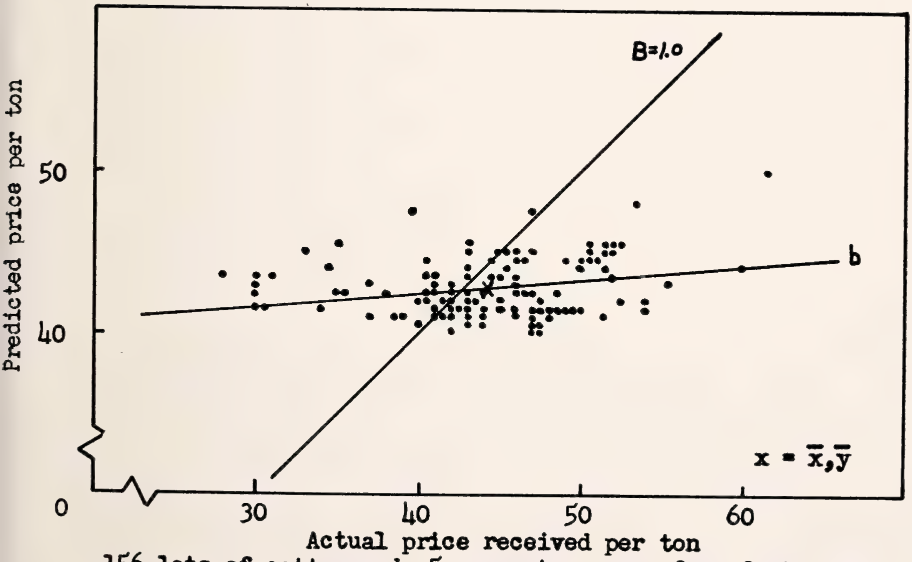


Figure 15.—Relationship between moisture-grade predicted prices and actual prices received, 718 lots of cottonseed, 2 percent or less free fatty acid.



228 lots of cottonseed, 2.1 to 4.9 percent free fatty acid



156 lots of cottonseed, 5 percent or more free fatty acid

Figure 16.—Relationship between moisture-grade predicted prices and actual prices received for cottonseed.

4.01 and 5.97. The small standard deviation of the mean for predicted prices in the 5 percent or more group as compared with that for actual prices indicates the tendency of predicted prices to cluster around the mean and their failure to fully reflect variations in actual prices received. The standard error of estimate was 1.60, 1.85 and 1.77, for the three acid groups, respectively. This means that approximately two-thirds of the predicted prices would not vary from the observed regressions by more or less than these amounts.

The average predicted price for all three acid groups combined was $56.28, while the average actual price received was $56.48 (Table 12). The small difference of —.20 was found not to be significant. This means that on the average there was no bias in moisture-grade predicted prices for all observations combined. The computed linear regression coefficient for all observations combined was 0.900. Tests revealed the coefficient was significantly different from 0 and 1.0, indicating a significant but imperfect relationship between predicted prices and actual prices received. The unbiased regression line ($B = 1.0$) passes through the means $\bar{x}$, $\bar{y}$. However, the computed line lies below it to the right of the mean and above to the left of the mean (Figure 17). This indicates that on the average the predicted price underestimates actual price received for values higher than the mean and overestimates the actual price received for values lower than the mean.

Approximately 88 percent of the variation in the predicted prices was linearly associated with actual prices received. The standard deviation of the mean for predicted prices was 7.86 as compared with 8.20 for actual prices received. The standard error of estimate was $2.71.

It must be remembered that the data for all observations were obtained by combining the predicted prices computed through the use of the appropriate equations for each acid group. The differences in the accuracy of the predicted prices between the various groups have been noted. As a result of these differences the scatter diagram for all observations forms a funnel shaped distribution with a pattern of positive relationship between the variables. This indicates that the pricing error becomes larger as the unbiased regression line falls from the right to the left. A larger pricing error is indicated for low valued seed. It is obvious that the standard error of estimate is not equal throughout the distribution. The scatter is quite large in the lower left hand part of the diagram, becoming smaller as it moves upward and to the right (Figure 17). The average standard error for the combined groups understates the error for low valued seed and overstates the error for high valued seed. Thus one would not be justified in using the average to correct errors

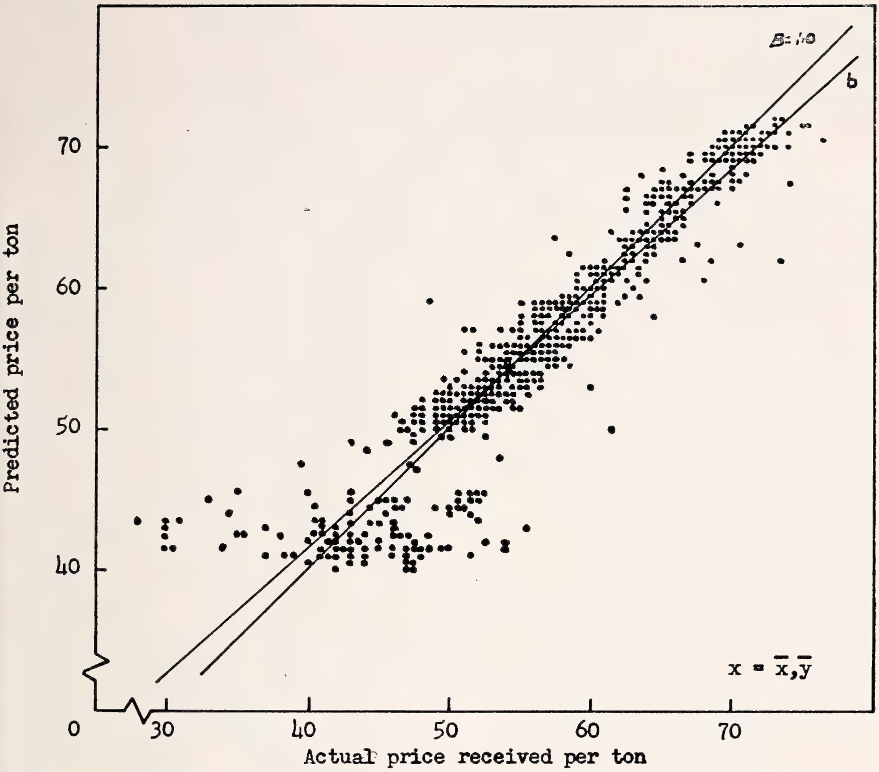


Figure 17.—Relationship between moisture-grade predicted prices and actual prices received, 1,102 lots of cottonseed.

in the observed regression. Attention is also called to the computed regression coefficient for the combined groups. It is in effect a weighted average of the three regression coefficients for the individual acid groups. It is slightly less than that for the 2 percent or less acid group and larger than that for either of the other two groups. It is anticipated that the analysis for the combined acid groups, for each alternative method of estimating grade, will be used for comparative purposes only.

Oil-Grade Predicted Prices

The three price prediction equations computed on the basis of the oil-grade estimates were as follows:

(1) For seed containing 2 percent or less free fatty acid:

$$P' = 33.62 + 3.686\ X\ (C)$$

(2) For seed containing 2.1 to 4.9 percent free fatty acid:

$$P' = 38.41 + 2.986\ X\ (C)$$

(3) For seed containing 5 percent or more free fatty acid:

$$P' = -56.12 + 7.132\ X\ (C)$$

In each equation X is the oil content, C is the oil mill base price for basis grade seed (grade 100) and P' is the predicted price.

The predicted price for any lot of seed may be calculated by inserting the applicable oil content and oil mill base price in the appropriate acid content equation. The predictions will be subject to the same error as was pointed out for the grade estimates. The above equations were used to predict the price of all lots of seed in each acid group included in the study. These data were then subjected to pricing error analysis similar to that used for moisture-grade predicted prices.

The average predicted prices based on the oil-grade estimates for the three acid groups were $60.12, $53.42 and $42.87, respectively. The average price received was $60.16, $53.22 and $44.34 for the three groups. The differences of — .04 and + .20 for the 2 percent or less and 2.1 to 4.9 percent free fatty acid groups were not significant, while the nega-

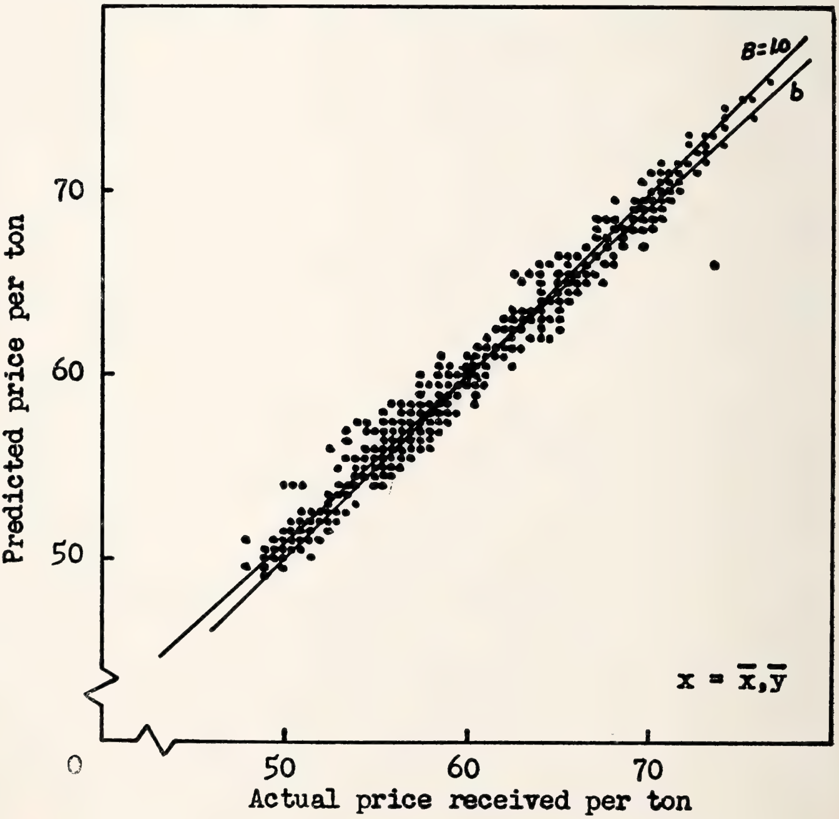


Figure 18.—Relationship between oil-grade predicted prices and actual prices received, 718 lots of cottonseed, 2 percent or less free fatty acid.

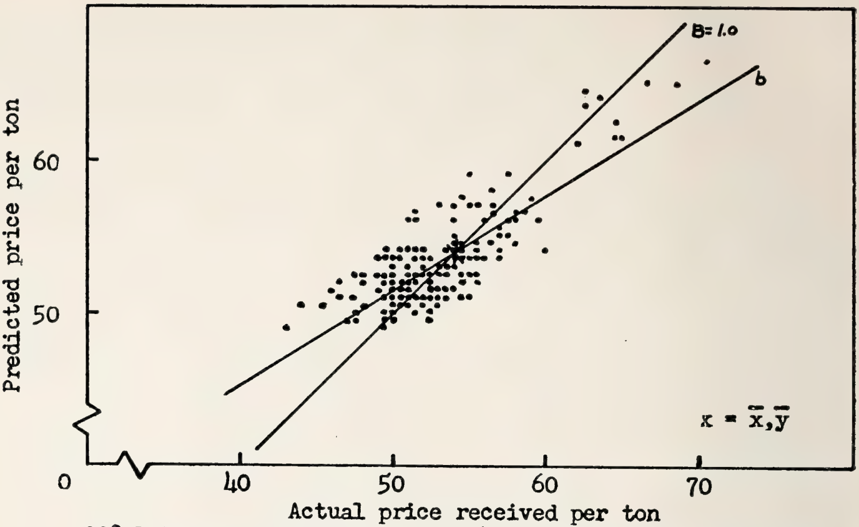
tive difference of 1.47 for the 5 percent or more group was found to be highly significant at the 1 percent level. This means that on the average there was no bias in the predicted prices for the two lower acid groups; there was a significant downward bias in the 5 percent or more group.

The computed linear regression coefficients for the three acid groups were 0.9230, 0.6275 and 0.2225, respectively (Table 13). The regression coefficients for the 2 percent or less and 5 percent or more acid groups were higher than the corresponding coefficients for the moisture-grade predicted prices. The regression coefficient was lower for the 2.1 to 4.9 percent acid group. Tests revealed that all of the computed regression coefficients were significantly different from 0 and 1.0. This means that there was a significant but imperfect relationship between the predicted prices and actual prices. The unbiased regression line ($B = 1.0$) passes through the means $\bar{x}$, $\bar{y}$ of both the 2 percent or less and the 2.1 to 4.9 percent free fatty acid groups (Figures 18 and 19). The computed lines lie below the unbiased line for observations greater than the mean and above for those less than the mean. This means that on the average the predicted prices underestimate the actual prices received for seed higher in value than the mean and overestimate the actual prices received for seed lower in value than the mean. This type error was quite small for the 2 percent or less acid group. The scatter of dots about the unbiased regression line was quite small for the 2 percent or less group, indicating a very small pricing error in this group.

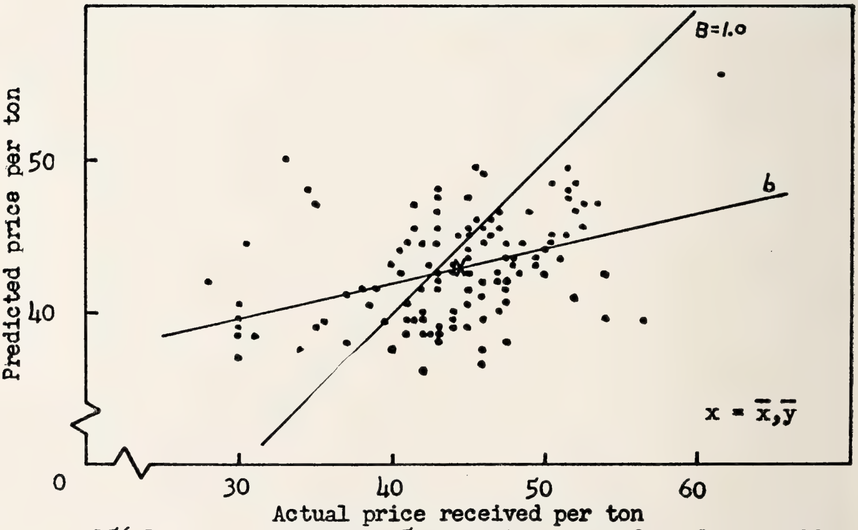
The unbiased regression line crosses the computed regression line below and to the left of the means x, y for the 5 percent or more acid group (Figure 19). The computed line lies below the unbiased line to the right of the point of intersection and above to the left of this point. On the average the predicted prices for higher valued seed underestimated the actual prices received while the predicted prices overestimated the actual prices for lower valued seed. This type error was relatively large as compared to the other two acid groups.

Approximately 97, 66 and 15 percent of the variation in the predicted prices was linearly associated with the actual prices received in the three acid groups, respectively. The standard deviation of the mean of predicted prices was 6.03, 3.10 and 3.42 for the three groups. The standard error of estimate was $1.06, $1.19 and $3.16.

The average predicted price for all three acid groups combined was $56.29, while the average actual price received was $56.48. The small difference of — .19 was not found to be significant, indicating that on the average there was no bias in the oil-grade predicted prices for all observations combined. The computed linear regression coefficient for



228 lots of cottonseed, 2.1 to 4.9 percent free fatty acid



156 lots of cottonseed, 5 percent or more free fatty acid

Figure 19.—Relationship between oil-grade predicted prices and actual prices received for cottonseed.

TABLE 13.—Summary analysis of regression of oil predicted prices on price received for cottonseed by ginners and price errors, by free fatty acid groups[a]

Items measured or computed	Number of observations			
	2% or less FFA[b] 718	2.1 to 4.9% FFA 228	5% or more FFA 156	All observations 1,102
Predicted price:				
Mean	60.12	53.42	42.87	56.29
Standard deviation	6.03	3.10	3.42	8.01
Price received by ginner:				
Mean	60.16	53.22	44.34	56.48
Standard deviation	6.43	4.01	5.97	8.20
Correlation coefficient	0.9846**	0.8115**	0.3881**	0.9489**
Coefficient of determination	0.9694	0.6585	0.1506	0.9006
Regression coefficient	0.9230	0.6275	0.2225	0.92709
Total sum of squares	26,089.22	2,187.02	1,814.11	70,613.70
Reduction in S.S. due to reg.[c]	25,291.97	1,440.07	237.28	63,594.22
Deviation from reg. S.S.	797.25	746.95	1,540.83	7,019.48
Variance of estimate S^2e	1.11	3.31	10.00	6.38
Standard error of estimate	1.06	1.19	3.16	2.53
Standard error of reg. coef.	0.006	0.030	0.043	0.009
(t) value for test Ho:b=1	12.58**	12.39**	18.26**	7.86**
(t) value for test Ho:b=0	150.82**	20.87**	5.23**	99.90**
Mean difference (error)	—.04	+.20	—1.47	—.19
Standard deviation	6.24	3.59	4.86	8.10
Standard error of mean	0.329	0.336	0.551	0.345
(t) value for test of hypothesis true mean difference = 0	0.122	0.595	2.668**	0.551

[a] Error equals predicted price minus actual price.

[b] FFA equals free fatty acid.

[c] S.S. equals sum of squares.

**Significant at .01 level.

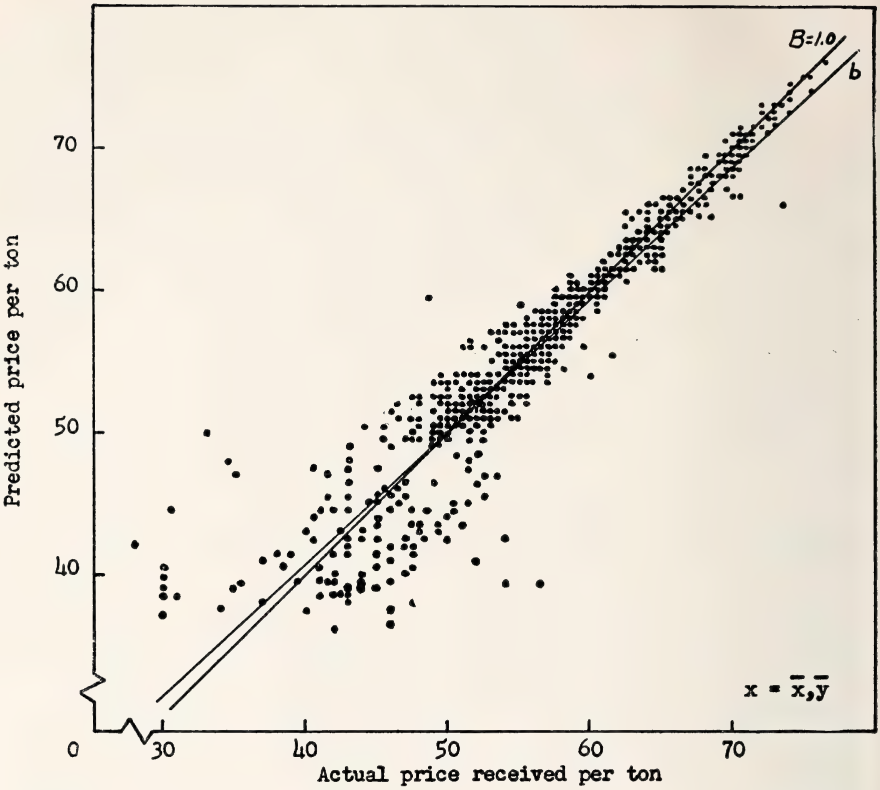


Figure 20.—Relationship between oil-grade predicted prices and actual prices received, 1,102 lots of cottonseed.

all observations was 0.9271. Tests revealed the coefficient was significantly different from 0 to 1.0, indicating a significant but imperfect relationship between the variables. The unbiased regression line (B = 1.0) passes through the means $\bar{x}$, $\bar{y}$ on the computed line (Figure 20). The computed line lies below the unbiased line for values higher than the mean and above the line for values less than the mean. This indicates that on the average there was no bias, but that high valued seed were underpriced and low valued seed were overpriced. This type error was quite small as measured by the distance between the two regression lines within the range of the data.

Approximately 90 percent of the variation in the predicted prices was linearly associated with actual prices received. The standard deviation of the mean of predicted prices was 8.01 as compared to 8.20 for actual prices received. The standard error of estimate was $2.53. It may be pointed out that the computed regression line does not vary from the unbiased line by more than the standard error of estimate within the relevant range of the data.

Oil-Moisture-Grade Predicted Prices

The three prediction equations computed on the basis of the oil-moisture-grade estimates were as follows:

(1) For seed containing 2 percent or less free fatty acid:

$$P' = 44.10 + 3.402\ X_1 - 0.567\ X_2\ (C)$$

(2) For seed containing 2.1 to 4.9 percent free fatty acid:

$$P' = 71.99 + 2.009\ X_1 - 1.270\ X_2\ (C)$$

(3) For seed containing 5 percent or more free fatty acid:

$$P' = -68.32 + 7.480\ X_1 + 0.469\ X_2\ (C)$$

In each equation X_1 is the oil content, X_2 is the moisture content, C is the oil mill base price for basis grade seed (grade 100) and P' is the predicted price.

The predicted price for any lot of seed may be calculated by inserting the applicable oil content, moisture content and oil mill base price in the appropriate acid content equation. The predictions will be subject to the same type error as was pointed out for the grade estimates. The three equations were used to predict the price of all lots of seed in each of the acid groups. These data were then subjected to pricing error analysis similiar to that used for the other predicted prices.

The findings of the pricing error analysis for the oil-moisture-grade predicted prices were very similar to those for the two preceding ones. The average predicted prices did not differ significantly from the average actual prices for the 2 percent or less and 2.1 to 4.9 percent acid groups, while the difference of — 1.47 for the 5 percent or more group was found to be significant (Table 14). The same relationship between the computed and unbiased regression lines was found, indicating that on the average the predicted prices overestimated the actual prices received for low valued seed and underestimated the actual prices received for high valued seed (Figures 21, 22 and 23). The computed regression coefficients for the three acid groups were 0.9542, 0.7561 and 0.2167, respectively. These were larger for each group than the corresponding coefficients for the other alternatives except for the 5 percent or more group. The regression coefficient for the oil-grade prediction was slightly larger than that for the oil-moisture-grade prediction for the 5 percent or more acid group. For all observations combined the computed regression coefficient 0.9460 was higher than for either of the other alternatives.

Approximately 98, 75 and 14 percent of the variation in the predicted prices was linearly associated with the actual prices received in the three acid groups, respectively. Approximately 91 percent of the variation for all groups combined was linearly associated with the actual prices received. Except in the 5 percent or more acid group, variations in the oil-moisture predicted prices were more closely associated with actual prices received than either of the two other alternatives. The standard deviation of the mean of the predicted prices was also larger in all except the 5 percent or more acid group, 6.21, 3.50, 3.41 and 8.13 for the three acid groups and all groups combined, respectively. The standard error of estimate was $0.91, $1.74, $3.16 and $2.45 for the three groups and all groups combined, respectively.

Within the relevant range of the data, the predicted prices based on the oil-moisture-grade estimate would be a highly accurate means of pricing cottonseed at the ginner market. During seasons in which the free fatty acid content did not exceed 4.9 percent, the pricing error involved in using this method could be expected to be very small.

TABLE 14.—Summary analysis of regression of oil moisture predicted prices on price received for cottonseed by ginners and price errors, by free fatty acid groups[a]

Items measured or computed	Number of observations			
	2% or less FFA[b]	2.1 to 4.9% FFA	5% or more FFA	All observations
	718	228	156	1,102
Predicted price:				
Mean	60.13	53.42	42.87	56.30
Standard deviation	6.21	3.50	3.41	8.13
Price received by ginner:				
Mean	60.16	53.22	44.34	56.48
Standard deviation	6.43	4.01	5.97	8.20
Correlation coefficient	0.9892**	0.8682**	0.3795**	0.9537**
Coefficient of determination	0.9785	0.7538	0.1440	0.9096
Regression coefficient	0.9542	0.7561	0.2167	0.9460
Total sum of squares	27,624.80	2,773.99	1,799.60	72,797.78
Reduction in S.S. due to reg.[c]	27,029.51	2,091.00	259.19	66,218.06
Deviation from reg. S.S.	595.29	682.99	1,540.41	6,589.72
Variance of estimate S^2e	0.83	3.02	10.00	5.99
Standard error of estimate	0.91	1.74	3.16	2.45
Standard error of reg. coef.	0.003	0.029	0.043	0.009
(t) value of test Ho:b=1	15.86**	8.50**	18.39**	6.00**
(t) value for test Ho:b=0	330.40**	26.66**	5.09**	105.13**
Mean difference (error)	—.03	+.20	—1.47	—.18
Standard deviation	6.32	3.76	4.86	8.16
Standard error of mean	0.334	0.353	0.550	0.348
(t) value for test hypothesis true mean difference = 0	0.009	0.567	2.673**	0.517

[a] Error equals predicted price minus actual price.

[b] FFA equals free fatty acid.

[c] S.S. equals sum of squares.

**Significant at .01 level.

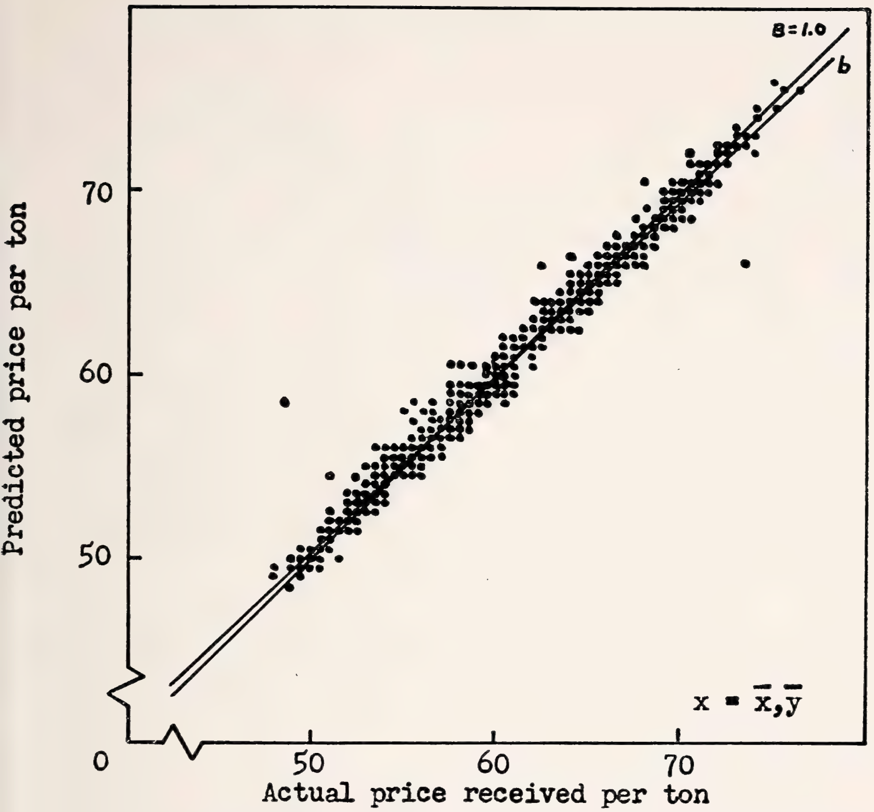
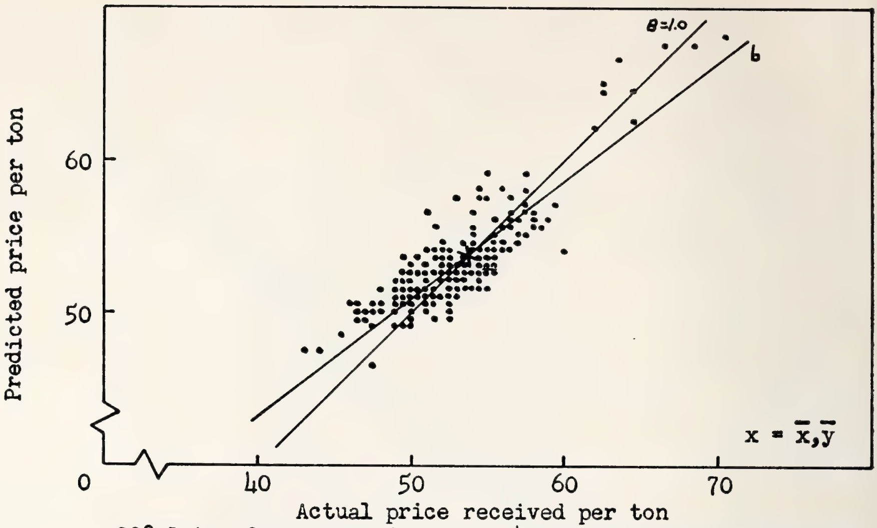


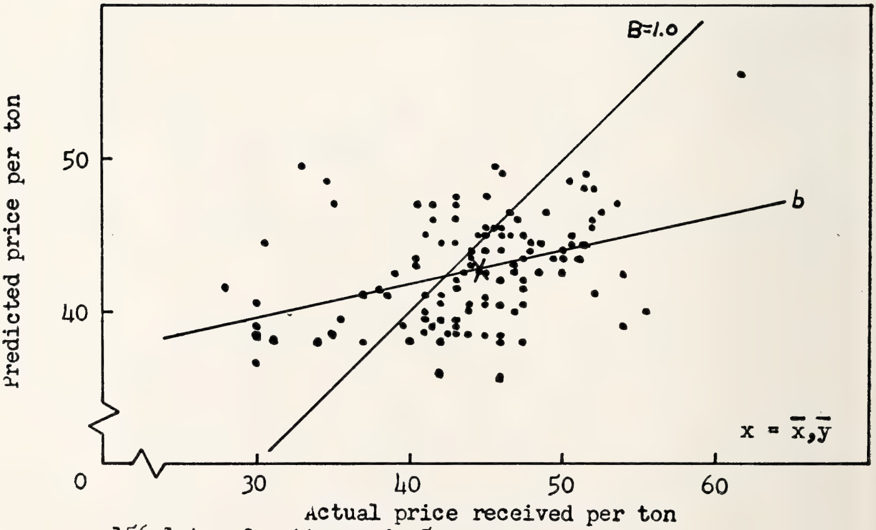
Figure 21.—Relationship between oil-moisture-grade predicted prices and actual prices received, 718 lots of cottonseed, 2 percent or less free fatty acid.

APPRAISAL OF PRICING ACCURACY OF SUGGESTED ALTERNATIVE PRICING SYSTEMS

The diagrams in the preceding sections have shown that the present pricing system, as well as each of the suggested alternatives, has certain pricing errors associated with its use in marketing cottonseed at the ginner market. Under each method the scatter of dots about the unbiased regression line indicated that some lots of cottonseed were priced above the actual price received while others were priced below. The scatter of dots about the unbiased line, however, was much greater for the present system than any one of the suggested alternatives and was greater for some alternatives than for others. This was especially noticeable for the lower free fatty acid content seed.



228 lots of cottonseed, 2.1 to 4.9 percent free fatty acid



156 lots of cottonseed, 5 percent or more free fatty acid

Figure 22.—Relationship between oil-moisture-grade predicted prices and actual prices received for cottonseed.

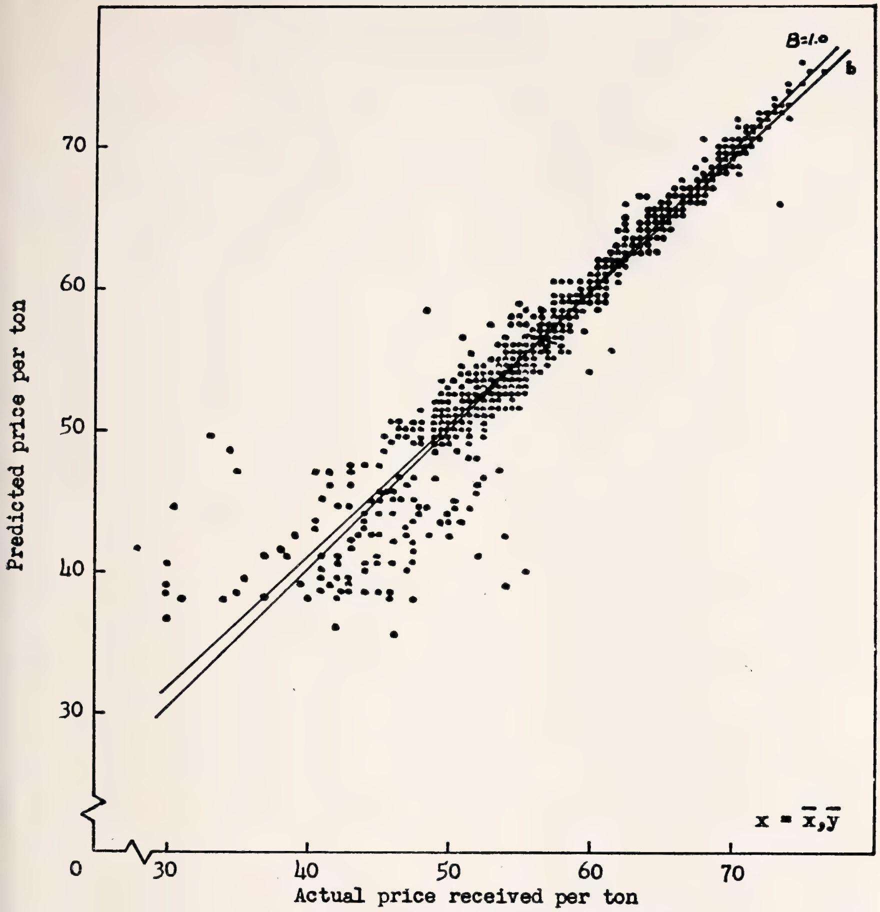


Figure 23.—Relationship between oil-moisture-grade predicted prices and actual prices received, 1,102 lots of cottonseed.

An appraisal of the various scatter diagrams showed that the pattern of prices was clearly quite different under the alternative methods from that under the present system. In the present system, prices arranged themselves in rather narrow bands extending horizontally across the chart (Figure 7). Under all three of the alternative methods the prices for the 1,102 lots were arranged much more closely around the unbiased regression line (Figures 17, 20 and 23). Where the free fatty acid content was less than 5 percent, the dots were arranged very closely around the unbiased line. The improvement was not so obvious for observations in which the acid content exceeded 5 percent.

There was also a noticeable difference in the pattern of prices about the unbiased regression line among the alternative methods. There was a larger scatter about the unbiased line for the moisture-grade predicted prices than for the other two alternatives. A difference was more difficult to discern between the oil-grade and oil-moisture-grade predicted prices.

A comparison of dispersion and the relationship of the variables in the present and alternative pricing systems is given in Table 15. The coefficient of determination was only 0.5935 for the present system as compared to 0.9096 for the oil-moisture-grade predicted prices. In other words, the variation in prices paid under the present system explained about 59 percent of the variation in prices received, whereas approximately 91 percent could be explained by the oil-moisture-grade alternative. The coefficient of determination was 0.8809 for the moisture-grade predicted prices, the lowest of the three suggested alternatives.

The relative pricing accuracy of each of the several pricing methods, measured statistically in terms of the variation in pricing errors, is shown in Table 16. The present system of marketing cottonseed re-

TABLE 15.—Comparison of standard error of estimate, correlation coefficients and coefficient of determination for various pricing methods, 1,102 cottonseed shipments

Pricing method	Standard error of estimate	Correlation coefficient	Coefficient of determination
Present pricing system	$4.31	.7704	.5935
Moisture-grade predicted prices	2.71	.9386	8809
Oil-grade predicted prices	2.53	.9489	.9006
Oil-moisture-grade predicted prices	2.45	.9537	.9096

TABLE 16.—Relative accuracy of pricing cottonseed by several alternative pricing methods, 1,102 cottonseed shipments

Item computed	Pricing Method				
	Present system	Moisture-grade predicted price	Oil-grade predicted price	Oil-moisture-grade predicted price	Optimum pricing system[a]
Variance of estimate	18.60	7.37	6.38	5.99	0.00
Percentage of column 1	100.00	39.6	34.3	32.2	0.00
Percentage reduction in variance based on column 1	— —	60.4	65.7	67.8	100.00
Ranking in pricing accuracy	fourth	third	second	first	optimum

[a] Optimum system would be one in which prices paid equal prices received for each lot of cottonseed.

sults in a certain variation of prices paid by ginners for seed above and below prices received by the ginner from the oil mill. This variation is a measure of pricing error: the larger the variability, the less accurate the pricing system; the smaller the variability, the more accurate the pricing system. If price paid had been equal to price received for each lot, the pricing errors would have all been zero, and the variability of pricing errors would have been zero.

In the comparison of pricing accuracy, the variation of pricing errors associated with the present method was used as the base against which the other pricing methods were compared.

The moisture-grade predicted price system appeared to be the least accurate of the three alternatives. However, even this method resulted in a reduction in pricing error of approximately 60 percent in comparison with the present method. The oil-moisture-grade prediction method was the most accurate method, resulting in a 68 percent reduction in pricing error. The oil-grade prediction method was only slightly less accurate than the oil-moisture-grade system, accounting for a 66 percent reduction in pricing error.

A still further reduction in pricing error that is not reflected in the diagrams or in the statistical analysis is that related to the pricing of individual lots of cottonseed purchased by the ginner. It may be assumed that the same degree of accuracy will be obtained in predicting the price of individual bale lots, using the various alternative methods, as that obtained in predicting the price received for individual shipments to the oil mill. It may also be assumed that a comparable, if not greater, reduction in pricing errors will result from the use of the alternative systems in pricing individual lots of cottonseed purchased by the ginner from the producer. The extent of this type error in the present system is not known. However, in view of the "flat price" custom, it could conceivably be quite large in cases where the quality of individual purchases was found to vary widely.

One of the most significant results to be expected from the adoption of any one of the alternative methods of pricing cottonseed at the ginner market is that farmers would be paid more nearly the true market value of the cottonseed they bring to the gin than is possible under the present system. As far as the farmer is concerned, the present system of pricing gives major consideration to the weight of the seed. Selling on the basis of the estimated-grade price would give consideration to value variations arising out of differences in quality as well as weights. The producer would select the gin which he wishes to patronize on the basis of a posted basis price at the gin rather than in terms of a posted flat rate for all seed.

These are the errors in pricing which should be considered in deciding whether the sale of seed by any one of the methods would or would not be a desirable improvement in the cottonseed marketing system. The reduction in errors indicates the improvement in accuracy which could be realized by selling on the basis of the alternative methods. They should be weighed against the possible increase in costs, and added inconvenience in marketing cottonseed by these methods. Whether or not one of the alternatives will be adopted and used will depend upon (1) the cost of performing the grading operations, (2) the extent of required changes in the present operational setup and (3) the support given to the suggested alternative methods by those outside the ginning industry. The additional cost involved in the use of the alternatives has not been ascertained. However, it is felt that it would not be excessive. Operational changes would mainly consist of making arrangements for performing the grading operations. Use of the alternatives would not involve any changes in the methods or timing of seed settlements with producers.

Limitations of the Study

Some of the limitations of the study have been pointed out in the analysis presented in each section. However, it was deemed advisable to reemphasize these as well as to point out others.

First, in the analysis of pricing errors in the present system it was assumed that the oil mill base price adequately reflected consumer demand for cottonseed products and that the premiums and discounts paid by the mill adequately reflected the differentials between grades. This was a necessary assumption in order to limit the scope of the study and it might not be necessarily true.

Second, it was assumed that the official chemical analysis was an accurate method of determining quality differences in cottonseed, and that there were no errors in the official grades. If there were any errors in the grading, these contributed to the magnitude of the standard errors of estimate in the analysis of grade factors and the analysis of grading errors for the different estimation equations. Since the official grade analysis is made on the basis of a small sample of seed, it is very likely that such errors exist.

A third limitation is the acceptance of the oil and moisture contents determined by the official grade analysis as the values that would be obtained by the use of the USDA meters. No tests were made in the study to confirm the reported results obtainable through the use of the meters.

A fourth limitation is the assumption that the reductions in pricing errors were due to the use of the alternative grade standards. Part of the pricing errors might have been due to the failure of the present system to reflect changes in the oil mill base price. If so, part of the reduction in pricing errors would have been the result of using the actual base price in the calculations.

A further limitation was the fact that the sample data for grades within each acid group was not stratified on any basis. This sampling procedure introduces a bias, the extent of which is unknown. The results could have been improved if the distribution had been known and used and weighted regressions had been computed. The fact that the data were stratified by acid content groups would reduce this bias to some extent. A second bias was introduced when the data were used to determine what relationships existed and then used as a basis of fitting the relationship to the data. The sample data were also used to determine the accuracy of the prediction equation. One would expect the prediction equation to fit the sample data with a high degree of precision.

A final limitation is the acceptance of the theoretical grade standards as alternative methods of pricing cottonseed. The operational efficiency aspects of the various alternatives were not determined in the study.

RURAL INDUSTRIALIZATION
A LOUISIANA COMMUNITY

ALVIN L. BERTRAND
HAROLD W. OSBORNE

tin No. 524

June 1959

Louisiana State University
and
cultural and Mechanical College
gricultural Experiment Station
Charles W. Upp, Director

In Cooperation With
Farm Population and Rural Life Branch
Agricultural Economics Division
Agricultural Marketing Service
U.S. Department of Agriculture

FOREWORD

In recent years, many industrial concerns have established plants in rural communities. This development affects rural people in several ways. It provides additional employment opportunities and income both for farm and nonfarm families in the rural area through the jobs provided in the plant, as well as in expanded service and trade establishments. This, in turn, leads to an increase in the local market for food and other products. In addition, human and capital resources that might otherwise leave the area are retained locally.

When many people change from farming to industrial work or to a combination of part-time farming and a nonfarm job, changes are likely to result in the economic and community life of the area. The Rural Development Program, under the sponsorship of six Federal Departments, includes studies of both economic and social effects of the introduction of industries to rural areas. Growth and economic development are also accompanied by problems of change and adjustment. The U. S. Department of Agriculture naturally favors developments that are likely to increase the incomes of rural people. But the Department is also concerned about the way in which these developments affect rural schools and churches, the general spirit of neighborliness, participation in community affairs, and the attitudes of rural people toward their community.

This report is based upon a recent study made by Louisiana State University and the U. S. Department of Agriculture. Its purpose was to find out how residents of a rural community in Louisiana have been affected by an industrial plant that began operations about 8 years ago. It shows that the community has benefited not only by getting larger incomes, but in other ways as well.

Other studies of the effects of rural industrialization, conducted jointly by the U. S. Department of Agriculture and the State Agricultural Experiment Station, have been made in Mississippi, Utah, Ohio, and Iowa.

True D. Morse

True D. Morse,
Under Secretary of
Agriculture and Chairman
of Committee for Rural
Development Program

Troy H. Middleton

Troy H. Middleton
President,
Louisiana State University

TABLE OF CONTENTS

Page
Foreword 3
Summary and Conclusions 6
    Summary 6
    Conclusions 8
Introduction 9
    Objectives 9
    Method of Study 10
    Description of the Study Area 12
    Theoretical Frame of Reference 13
Personal-Social Characteristics of Interviewees 14
    Plant Employees 14
    Heads of Open-Country Households 17
Residential Characteristics and Mobility of Interviewees 20
Occupational Characteristics and Mobility of Interviewees 23
Interviewees' Feelings About Industrial Work 27
Impact of Rural Industry on the Levels of Living of Interviewees . . 30
Impact of Industrialization on Social Participation 33
The Impact of Industrialization on Community Life 36
    A Note on Community-Factory Relations 39

LIST OF TABLES

Page
1. Weekly Earnings of Plant Employees, Classified by Race and Sex 16
2. Index of Mobility (Number of Residences in Past 10 Years) of Interviewees 21
3. Type of Last Move of Interviewees Having Moved in the Preceding 10 Years 22
4. Number of Jobs of Interviewees Since 1947 24
5. Type of Last Job Change Reported by Interviewees 25
6. Farm and Nonfarm Job Training of Interviewees 26
7. Type of Formal Social Participation of Interviewees 34
8. Index of Degree of Social Participation of Interviewees 34
9. Comparison of Degree of Present and Past Social Participation of Interviewees 35

LIST OF ILLUSTRATIONS

Page

1. Study Area 11
2. Characteristics of Plant Employees 15
3. Characteristics of Heads of Open-Country Households 18
4. Number of Residences of Plant Employees in Past Ten Years 21
5. Type of Last Occupational Change of Plant Employees 25
6. Job Conditions Ranked Most Important by Plant Employees 29
7. Job Conditions Ranked Most Important by Open-Country Respondents 29
8. Percentage of Plant Employees Owning Seven Level-of-Living Items. 1950 and 1957 31
9. Percentage of Open-Country Respondents Owning Seven Level-of-Living Items, 1950 and 1957 31
10. Opinions of Plant Employees on Change in Selected Areas of Community Life in Past Five Years. by Race 37
11. Opinions of Open-Country Sample on Change in Selected Areas of Community Life in Past Five Years. by Race 37

SUMMARY AND CONCLUSIONS

This study was undertaken to determine the impact of industry in rural areas. Information was obtained through the use of the field survey technique in an area where an industrial plant had begun operation six years previously. The focus of the study is apparent in the five basic questions for which an answer was sought. These questions and the findings relating to them provide a logical organization for the summary of the report.

Summary

1. Whom does a rural industry employ? The majority of the employees of the plant were recruited from the local area and most of them (two-thirds) lived in rural places. Three-fourths of the workers were male and three of every five employees were Negro. The workers were relatively young, had relatively little schooling, and most of them were married.

Workers represented a fairly stable group characterized by strong ties to their home community. They had little knowledge of the labor market and indicated they would hesitate to move even if they knew of job opportunities elsewhere. Most of them had little or no formal job training of any kind. However, most of them had some previous non-farm work experience of an unskilled or semi-skilled nature. They received minimum wages for the most part, but their income compared well with other persons and families in their communities. The workers considered themselves relatively "well off" compared to others in their community.

The workers studied were characterized by some important value orientations. Not only were they prone to stay in their local community, but they apparently lacked incentive to change their present social status. Outside the family, their social participation was largely restricted to the church, with little time allotted to community affairs or group recreation.

2. How does rural industry affect the economic and social well-being of a community? From an economic standpoint, the wages received by the workers were very important to community welfare. Employees have generally increased their ownership and use of such things as refrigerators, washing machines, automobiles, television sets, etc., since taking their jobs. Employees and nonemployees alike felt that the plant had been beneficial to the community.

Though the economic life and well-being of workers had improved considerably after factory employment, their social life was affected much less. The sample population did not participate in a wide variety of formal activities and there is little indication that industrial employment served to increase their social participation or change leisure time patterns.

3. How does rural industry affect the agricultural practices in a community? The answer gained from this study is, simply, little or not at all. The type of farms on which workers live (small, non-commerical, non-specialized) permitted them to maintain operation at close to the same level as before. Where changes were made, it was generally an attempt to lessen labor requirements by substituting certain livestock and crop enterprises for others. The pattern of future farm operation is evidenced by the fact that most of the persons on farms planned little change.

4. How does industry affect the social institutions in a rural community? It can be concluded from reports of interviewees that industrialization has had some impact on community social institutions. According to the majority of interviewees of both sample populations, schools and churches in the community were changing for the better, if slowly. It should be noted that a considerable number of persons did not agree with this view.

The opinion that neighborliness and community pride had not changed significantly was expressed by most interviewees. In the light of the above, the major contribution of industry to social institutions is apparently in keeping people in the community, by providing them with an additional source of income. This view is strengthened by the consensus of interviewees that the presence of an industrial plant had improved their chances to "get ahead."

5. What are the attitudes of rural people toward industrial employment? Interviewees had mixed feelings about industrial work. Persons with work experience of this type had a slight preference for it; others were not sure on this point. A paradox appears in the fact that persons without industrial employment experience tended to hold a glamorized view of factory work. However, the farmers in this sample generally had not sought non-farm jobs and most of them definitely planned to continue farming. Plant employees were more likely to hold favorable opinions about the beneficial aspects of industrial employment than nonemployees.

Conclusions

Certain general conclusions may be derived from the study. First, low income rural areas do represent a potential source of employees to industry. These employees will be unskilled for the most part, young, and willing to work for relatively low wages. Many of them will not travel out of their communities in search of outside employment as long as they can "get by" there. This suggests that rural locations will be especially attractive to industries demanding large numbers of unskilled workers. However, an industry which does not attempt to identify itself with and support the local community will not enjoy complete success.

Second, it is apparent that certain types of industrialization can represent a way out for low-income rural communities in terms of personal income and levels of living. However, findings of this study do not justify the anticipation of great change in social participation and community social institutions. This finding is explained in terms of the situational approach used in sociology. In this instance the situation was not unique and crisis bearing, and thus did not necessitate change. Most of the plant workers and many of the members of the community had previously been employed in off-farm work, and their life habits and behavior patterns were not affected greatly. It is apparent that many persons in rural areas will not work in situations where their values are not understood or must be changed radically. The latter finding emphasizes the point that one of the basic causes of the persistence of certain socio-economic problems in low-income rural areas is the culturally based value systems to which the people hold. In other words, social situations which appear to administrators and planners as intolerable may be considered quite acceptable to local residents, if they permit the perpetuation of situations and values which are cherished highly. The present study suggests this is an area where further research would be fruitful.

Rural Industrialization In a Louisiana Community

ALVIN L. BERTRAND* AND HAROLD W. OSBORNE**

INTRODUCTION

The special Presidential message on agriculture addressed to Congress on January 11, 1954, placed new emphasis on the need for basic economic changes in certain farm areas. Attention was sharply focused on the need for improving levels of living on small farms and a broad program of action designed to achieve this aim was outlined. This program, designated as the Rural Development Program, has been in operation for approximately four years. Along with other things, it has supported basic cooperative research among certain Department of Agriculture agencies and various Land Grant Colleges and Universities. The findings of one such cooperative effort are reported in this publication.

Recommendations made in connection with the Rural Development Program clearly indicated it was to be more than an on-the-farm improvement movement. A major goal was to raise levels of living of low-income farmers through balancing agriculture with industrial and business development. This goal was set in view of the insufficient opportunities for persons in many low-income agricultural localities. It was suggested that the development of industry in rural areas would make possible higher levels of living. The impetus for this study of the impact of industrialization on a rural area was derived from the above suggestion.

Objectives

The general aim of the study was to determine the effects of new industries in rural areas on levels of living, occupational adjustments, migration patterns, and individual family incomes of both employee and nonemployee families. Specific objectives were:

---

*Department of Rural Sociology, Louisiana Agricultural Experiment Station, and Farm Population and Rural Life Branch, Agricultural Marketing Service, United States Department of Agriculture (while on leave from Louisiana State University). Note: Paul H. Price also contributed to this project on behalf of the Louisiana Agricultural Experiment Station before his untimely death in September, 1958.

**Formerly cooperative employee of the Department of Rural Sociology, Louisiana Agricultural Experiment Station, and Farm Population and Rural Life Branch, Agricultural Marketing Service, United States Department of Agriculture. Presently assistant professor, Department of Sociology, Baylor University.

(1) To appraise the relative contribution of agricultural manpower to the personnel of new industry.

(2) To appraise the demographic implications of rural industrialization, with particular reference to the age, sex, marital status, racial make-up, and educational level of employees of rural industries.

(3) To determine the influence of industrial development on the levels of living of the employee families residing in the open country and upon the levels of living of families generally in the area.

(4) To evaluate the effects upon agricultural enterprises in the area, including a determination of the specific changes occurring on the farms of operators employed in industry.

(5) To study the implications of the industrial development for action programs of the State and Federal governments, such as the Agricultural Extension Service, the Public Health Service, the Social Security Administration, and the Rural Development Program.

Method of Study

Louisiana provided an excellent laboratory for a project of this kind. Not only were there areas in the state agriculturally disadvantaged and steadily losing population, but certain areas were rapidly industrializing.

The first methodological problem to be solved was the location of a suitable study area. This problem was complicated by the requirements set up for the sample locality. To fulfill the objectives of the study, it was necessary that it be done in a relatively low-income rural area, where a sizable industry had located within the past five or six years. After thorough review of the records of the Louisiana State Department of Commerce and Industry on location, size, and year of first operation of industries in the state, the field was narrowed down to half a dozen potential survey areas. All of these were visited by members of the research team to sound out the local management of the respective plants and to determine the suitability of the locality for the study in mind. It was decided the research design criteria were best met by a small community, located in southeastern Louisiana, in Tangipahoa Parish (see Figure 1). A wirebound box company was located in this small town. This plant began operation in 1951 and employed approximately 500 persons. Since its raw material, wood, is commonly used by rural industries, it had another advantage for the research planned. In addition, one of the pilot counties of the Rural Development Program was partly within its area of influence.

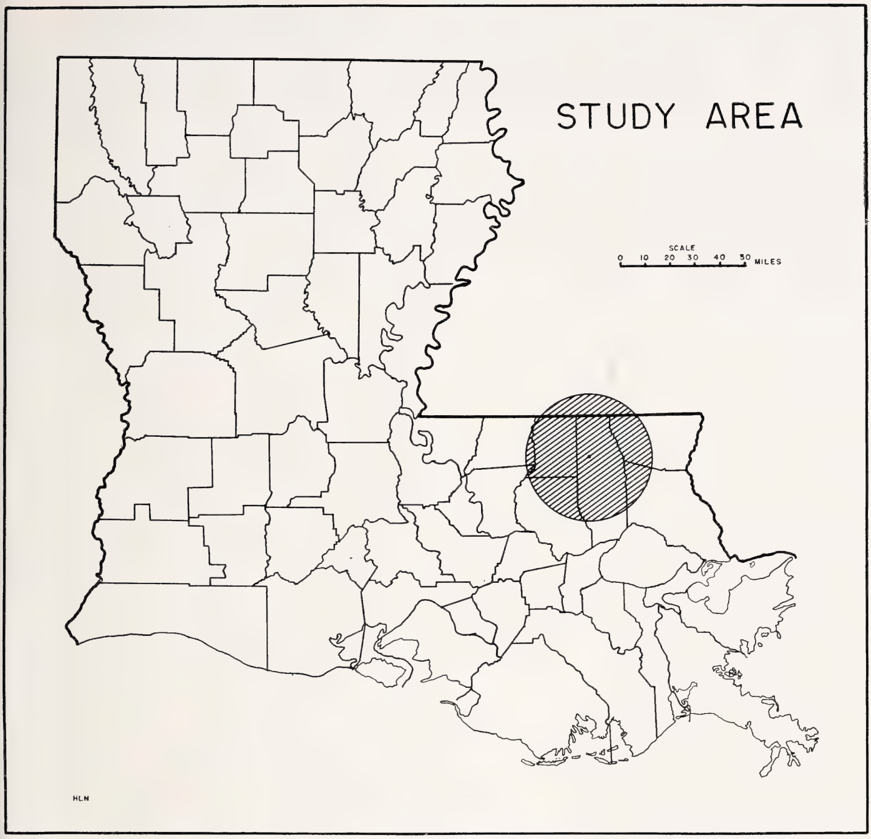


FIGURE 1.

Two questionnaires were prepared. The first, for plant employees, was designed to determine their characteristics and the changes which had taken place in their levels of living since entering industrial employment. In addition, quesions were included regarding their motivations for, and satisfaction with, industrial employment. The second questionnaire, to be used in the interview of a sample of open-country families within commuting distance of the wirebound box factory, was designed to obtain information regarding the effects of industry on their levels of living, agricultural activities, and other life habits. Both schedules included the usual basic information on demographic and socio-economic characteristics.

Different sampling methods were utilized for the two sample populations. For the employees, a 40-per cent sample was selected and 204 employees were interviewed. Names were drawn at random from an alphabetical list of employees. For the open-country study, probability area sampling was done within the commuting area, a 25-mile radius from the box factory. This sampling was done by the Division of Statistical Clearance and Standards, Agricultural Marketing Service, U. S. Department of Agriculture. The method of sampling involved two steps: (1) subdividing the entire area within the limits of the defined population into area segments or sampling units having identifiable boundaries, and (2) selecting the desired sample of these segments. In this instance, enough segments were drawn to satisfy the pre-determined requirement of about 300 nonemployee, open-country interviews.

Description of the Study Area

The study locality is located in the southeastern part of Louisiana, in what is commonly known as the Florida Parishes area. Parts of four parishes, Tangipahoa, Livingston, St. Helena, and Washington, are included in the primary sample area. Estimates based on 1950 census data indicate some 43,730 persons live within a radius of 25 miles from the community in which the box factory is located. It was impossible to get detailed information on this particular group, however, and the data below are for the parishes as a whole. Actually, there is a certain advantage in knowing the characteristics of the greater surrounding area.

The population of the above four parishes was 120,656 in 1950. Of this number, 27 per cent were classified as urban residents, 31 per cent as rural-nonfarm residents, and 42 per cent as rural-farm residents. These parishes are much more rural than the state as a whole. In fact, the proportion of rural-farm population in the parishes in the study area is just double that of the state.

There is little difference in the racial composition of the residents of the four parishes from that of the state. In 1950, 30 per cent of the population of the sample parishes and 33 per cent of the population of the state were nonwhites.

The educational attainment of persons in the sample parishes is slightly higher than the median of grades completed for the state. The median number of school years completed ranged from 7.4 years in St. Helena to 8.2 years in Washington in 1950. The relative youth of the sample area population is manifest in the fact that almost one-half were less than 21 years of age at the time of the last census. Typical of rural areas, a relatively large proportion of the persons 14 years and over, 69 per cent in 1950, were married. Relatively few, 9 per cent, were widowed or divorced.

Dairy farming is perhaps the most important agricultural enterprize in the area. However, there are considerable acreages devoted to strawberries and vegetable crops and to tung orchards, cotton, and beef cattle. Pine and hardwood forests are found throughout the region and represent a major source of off-farm income. Farms are generally small in size, averaging 59 acres in 1954. Many of them are in cutover areas where productivity is low. The average value per acre of farm land and buildings in the four parishes was $123 in 1954. This figure is somewhat inflated by the higher values in Livingston and Tangipahoa Parishes, where land has been bought for investment, recreational, and other nonfarm purposes. For example, an acre of farm land was worth only $64 in St. Helena Parish as compared to $177 in Livingston Parish. Almost all farms are family owned and operated. This is indicated by the low rate of tenancy, 14 per cent in 1954.

The above brief description clearly indicates the suitability of the study locale for the research. How important the under-employment and unemployment problem is in this area and similar areas is indicated by the flight of older farm youth from the four parishes from 1940 to 1950. In 1950, there were over one-third fewer youths and young adults 15 to 29 years old living in the four parishes under study than in 1940.

Theoretical Frame of Reference

This study is sociological in nature, and it seems appropriate to briefly outline its broad frame of reference. The approach employed is what has been termed the "situational" model.[1] This approach assumes individuals and groups behave in accordance with the way in which they define a situation. In other words, people act according to their particular interpretations, which may be different from the interpretations of "outsiders" with different value orientations. Thus, as long as routine situations are confronted, behavior is patterned and predictable in terms of one's experiences. This is true because society, through the socialization process, provides individuals with cultural norms or "predefinitions" for meeting situations. When a new or unique situation comes up and there is no previous experience to draw upon in terms of established behavior patterns, the individual or group is faced with a "crisis." If these crisis situations are violent enough they prevent the return to old patterns, and thus bring about changes in behavior.

---

[1] See: W. I. Thomas and Florian Znaniecki, *The Polish Peasant in Europe and America,* 2nd ed., New York: Alfred A. Knopf, 1927, and C. J. Lammers, *"The Situational Approach", Studies in Holland Flood Disasters,* 1953. Washington Committee on Disaster Studies of the National Academy of Sciences, National Research Council, 1955, Vol. II, Part II, pp. 118-122.

The coming of an industry could be defined as a new situation in a rural community. The impact of the industry upon the community would thus be understood in terms of how great a situational change the industry represented for individual residents. In other words, in theory, the change in the community would be closely correlated to the "crisis bearing" nature of industrial employment. On the one hand, such employment might represent a completely unique "situation" and bring about radical changes in community life and organization, if accepted. On the other hand, such employment might represent only a slight situational change and thus disrupt present patterns minimally.

PERSONAL-SOCIAL CHARACTERISTICS OF INTERVIEWEES

The purpose of this section is to describe the personal chacteristics of plant employees and heads of households in the sample populations. A knowledge of these characteristics is basic to an understanding of the discussions which follow. The descriptions of each characteristic are necessarily brief because of space limitations, but the detailed information may be obtained from the tables and charts included.[2]

Plant employees and heads of open-country households are considered separately in the discussion since the two groups are not directly comparable.

Plant Employees

A most important question for those interested in rural industrialization programs is, "What kind of person does a plant of a certain type employ?" The discussion which follows is designed to answer this question, insofar as a factory manufacturing wirebound boxes and allied wooden products is concerned. As noted, the conclusions presented are derived from an analysis of a random sample of some 204 of the plant's approximately 500 employees. The data relating to the personal characteristics of these employees are summarized in Figure 2.

Most plant employees lived in rural areas. The data collected show that 35 per cent of the employees interviewed were residing on farms. Approximately 28 per cent were living in the open country but were not farming and 37 per cent lived in a town or village center. Altogether, two-

---

[2] For a comprehensive report on the plant employee sample population see: Paul H. Price, Alvin L. Bertrand, and Harold W. Osborne, *The Effects of Industrialization on Rural Louisiana*: *A Study of Plant Employees,* Baton Rouge: Department of Rural Sociology, Louisiana AES and Agricultural Marketing Service, U. S. Department of Agriculture cooperating, January 1958.

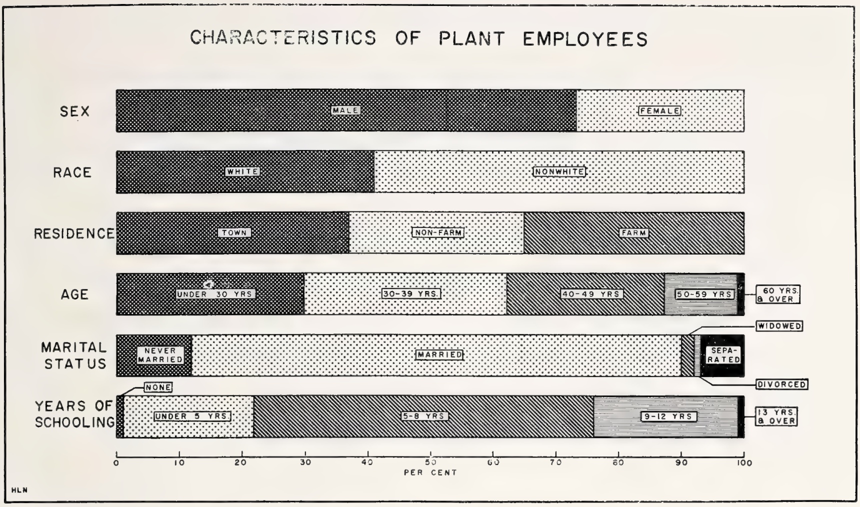


FIGURE 2.

thirds of the employees resided in rural areas. This finding indicates that industries locating in rural areas can and will use local workers.

The majority of employees were males. In this day and time, it is not unusual to find women working in industries of all kinds. It is significant that as many as 27 per cent of the plant employees were women. This finding indicates that rural industries, like urban industries, are likely to use women and that rural women will work at nonfarm jobs. It is interesting that a larger proportion of the white employees (31 per cent) than of the Negro employees (24 per cent) were women.

The majority of employees were nonwhite. Almost three-fifths (59 per cent) of the plant employees were nonwhite. This percentage seems high in view of the fact that about 30 per cent of the total population of the four parishes included in the study area is Negro. It is possible that more of the whites are full-time farmers and not in need of supplementary employment. Also, the type of work involved might appeal more to Negroes than to whites, or, it might be that there is higher general unemployment among Negroes. Whatever the reason, the fact holds.

Employees were relatively young. A considerable part of the work at the factory involves rather strenuous physical exertion. Because of this, one might expect a preponderance of persons in the younger ages among employees. Actually this age pattern was predominant. The median age for all workers was 35.7 years. Three out of every 10 of the employees were under 30 years. At the other extreme, only 13 per cent were 50 years and older and only one per cent were 60 years or older. The largest number (some 32 per cent) in any 10-year age group was in the 30 to 39 age group.

Employees had relatively little schooling. The average educational attainment of rural persons in the South is not high, and it is lower for Negroes than whites. Thus, one would expect a relatively low degree of educational attainment. Actually, the median number of school years completed by plant employees was only 7.0 grades. Although this is considerably lower than the national figure, it compares fairly well with the median number of years (7.6) completed by adult Louisianians. Significantly, it is considerably higher than the median (5.6) for the rural-farm and (6.5) for rural-nonfarm populations of the state.

Most employees were married. Rural areas generally have a higher percentage of persons 14 years old and over who are married, and it could be expected that this would hold true for the plant employees. Seventy-eight per cent of them were married. Only 12 per cent of the sample group had never been married, while 7 per cent said they were separated, 1 per cent were divorced, and 2 per cent were widowed.

A higher percentage of male than female employees were married. This might be expected in an industrial plant employee group, as married women are not as likely to be working at gainful employment.

Employees generally received near minimum wages. It is not surprising to discover that the large majority, three-fourths, of the employees of the plant earned $35 to $44 per week. (See Table 1.) The type of unskilled work common at this factory would normally be

TABLE 1.—Weekly Earnings of Plant Employees, Classified by Race and Sex

Weekly Earnings	Total		Race				Sex			
			White		Nonwhite		Male		Female	
	No.	Pct.	No.	Pct.	No.	Pct.	No.	Pct.	No.	Pct.
$25-34	20	10	10	12	10	8	9	6	11	20
$35-44	153	75	44	53	109	90	110	74	43	78
$45-54	15	8	13	16	2	2	15	10	0	—
$55-64	7	3	7	8	0	—	6	4	1	2
$65-74	2	1	2	3	0	—	2	1	0	—
$75 and over	7	3	7	8	0	—	7	5	0	—
Total	204	100	83	100	121	100	149	100	55	100
Median Earnings	$40.40		$42.20		$39.60		$41.00		$38.80	

done at or near the minimum wage rate of $1 per hour. In addition, high wage rates are not usual in rural areas. Certain supervisory and skilled workers earned higher wages, of course. The higher incomes were distributed among employees as follows: 8 per cent earned $45-$54 per week, 3 per cent earned $55-$64 per week, 1 per cent earned $65-$74 per week, and 3 per cent as much as $75 a week and more.

Comparisons of the wages of men and women indicate the men had a slightly higher median wage. The difference was only $2.20 per week, however. The supervisory positions of whites is indicated by the fact that this group earned more, on the average, than nonwhites The difference in the median weekly earnings of the two racial groups, however, was only $2.60.

The reported income of employee families compared well with that of the average rural family. The median family income, including net farm income as well as nonfarm income, reported for all family members of plant employees was $2,590 in 1956. This amount is low when compared to the income of urban families or families in more prosperous farm areas. However, it is significant that the reported family income of employee families was considerably larger than that reported by the average open-country family in the sample population. The median family income reported by the latter group was only $2,000 in 1956. It may be noted that fewer employee families than open-country families listed income from social security, public welfare, or other types of retirement or charitable sources.

Heads of Open-Country Households

The location of the open-country sample population was described in the introduction. Altogether, persons from 307 such families were interviewed. Wherever possible the head of the household was questioned. When heads of houses were not available, their spouses or other responsible adults were interviewed. The personal characteristics of heads of households were ascertained in each instance and are described below. The reader should be careful in making comparisons between the characteristics of employees and those of heads of households in the open-country sample population, as the former are not necessarily heads or spouses of heads of households. The data for this section are presented in summary fashion in Figure 3.

Most open-country families lived on farms. It may be noted that urban and village residents were ruled out of the open-country sample population by definition. Eighty-five (28 per cent) of the families interviewed lived in the open-country but not on farms. The remainder

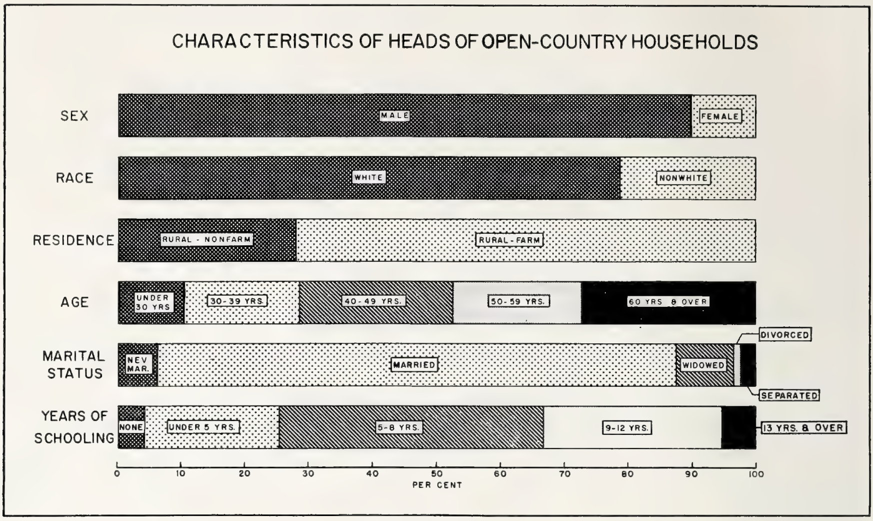


FIGURE 3.

of the families (222) were rural-farm. The proportion of rural-farm and rural-nonfarm residents was roughly the same as shown above for both the whites and nonwhites in the sample population.

The majority of the heads of open-country households were male. This, of course, is what one would expect. Only one-tenth of all heads of households were women, a proportion which is in line with the findings of previous studies of rural households. Among white households, only 7 per cent of the heads were women, but among nonwhite households 18 per cent of the heads were females. This finding, too, corroborates the findings of previous research. The high proportion of female heads of households among the nonwhites is typical. It is also commonly expected that there will be fewer female heads of households living in rural-farm than in rural-nonfarm areas. This pattern persists among the families interviewed.

Only one-fifth of the open-country residents were nonwhite. This percentage was lower than that reported for the state (33 per cent) and the four parishes (30 per cent) in 1950. It could well be a reflection of the general trend for Negroes to migrate from rural areas.

Heads of open-country households were relatively old. The median age of the heads of households of the families in the open-country sample population was 49.3 years. Only one out of every ten was under 30 years. However, half were at least 50 years old and one in four (28 per cent) was 60 years of age or older.

Female heads of households were considerably older, on the average, than male heads. The median age for the former was 61.2 years as compared with 48.4 years for the latter. This differential is understandable in the light of the fact that so many of the women were widows, a finding that will be discussed later.

There was little difference in the median age of white and nonwhite heads of households. However, a large percentage of the latter were less than 30 years old, while relatively more whites were 40-49 years old.

The educational attainment of household heads was low. Yet, it was somewhat higher than that of the average rural Louisianian. The median years of schooling completed by the heads of the households interviewed was 7.1 years, whereas the median for the rural-nonfarm population of the state is 6.5 years, and for the rural-farm population 5.6 years. A detailed analysis shows that 4 per cent of the household heads had no schooling whatsoever and an additional 21 per cent had attended school less than five years. Over one quarter (28 per cent) had completed from 9 to 12 years of schooling. Only 5 per cent had some type of schooling beyond high school.

Male heads of households had slightly more formal schooling than female heads of households. This is a finding which must be interpreted in light of the fact that the median age of females was greater. Whites had a somewhat higher degree of schooling than nonwhites.

Male heads of households were generally married, whereas most female heads of households were widowed. This is the pattern usually found in rural areas and one which relates in part to the greater longevity of women. Altogether 82 per cent of the open-country heads of households were married. More of this group were widowed (9 per cent) than never married (6 per cent). Only 2 per cent were separated and just 1 per cent were divorced.

It is interesting to note that more than 9 out of 10 of the male heads were married, but none of the female heads were married. This is a reflection of the traditional role of males and females, as the husband would be classed as head, were he alive. Twenty-two out of 30 of the female heads were widowed, but only 2 per cent of the male heads' wives were deceased. Racial comparisons indicate that relatively more whites were married and relatively more Negroes were widowed.

The reported income of open-country families was relatively low. The median income reported by open-country families was only $2,000. This sum represents the combined net farm and nonfarm income reported for all family members. Approximately two-thirds of the open-country families interviewed reported less than $1,000 net farm income in 1956. Only 4 per cent said they had a net farm income of $5,000 or more.[3] It can be seen from the above than farm families in low income areas generally have a need to supplement their incomes from nonfarm sources.

RESIDENTIAL CHARACTERISTICS AND MOBILITY OF INTERVIEWEES

Modern improvements in communication and transportation have combined to facilitate residential mobility in the United States, and movement from one geographical location to another can be accomplished with relative ease by the average person. This fact made it important to study residence changes of interviewees. Mobility might indicate anything from shifts in occupation for economic advantage to wanderlust or instability. At the same time, reluctance to move might be an indication of apathy; or strong social ties to home, family, and community. The present location of interviewees, their frequency of moves, and their stated reasons for moving are reported here.

Plant employees tended to live closer to town than the average rural person. This is expected, as there is a natural tendency for a person living near a plant to seek employment in it. Almost two-fifths of the employees interviewed lived in a town near the Roseland Factory, 29 per cent lived less than three miles from a town, and 23 per cent resided 3-6 miles from a town. Only 22 per cent of the open-country interviewees were as close to a town as three miles, and 39 per cent lived 3-6 miles from the nearest town. Almost one-fourth of them were 6-9 miles from a town, but only 7 per cent of the plant employees were this far from an urban center. As many as 15 per cent of the open-country respondents, but just 2 per cent of the plant employees lived at least 10 miles from a town.

Employees were more mobile than the average rural person. Table 2 shows that employees of the Roseland Factory tended to change residence at relatively frequent intervals. Three out of every 10 had lived in two residences during the past 10 years, and 16 per cent had lived in as many as three residences in 10 years. Approximately 6 per cent of the employees interviewed had lived in four different houses in

---

[3] Estimates obtained from the Farm Income Branch, Agricultural Economics Division, Agricultural Marketing Service of the U. S. Department of Agriculture, indicate the average net farm income in Louisiana was $1,311 in 1957, and evidence the validity of the income reported by interviewee families.

TABLE 2.—Index of Mobility (Number of Residences in Past 10 Years) of Interviewees

Number of Residences	Open-Country		Plant Employees	
	Number	Per Cent	Number	Per Cent
One	191	62	80	39
Two	63	20	61	30
Three	28	9	33	16
Four	12	4	12	6
Five	8	3	13	6
Six or more	5	2	5	3
Total	307	100	204	100

the previous decade. Less than two-fifths (39 per cent) of them had not moved during the past 10 years. (See Figure 4.)

Interviewees living in the open country and not employed at the Roseland plant were more stable in residence. Over three-fifths of them (62 per cent) had lived in the same house for the past 10 years. Only one-fifth had lived in as many as two houses, and just 9 per cent had residence experience in three different homes. Less than one-tenth (9 per cent) had lived in as many as four houses in the preceding 10 years.

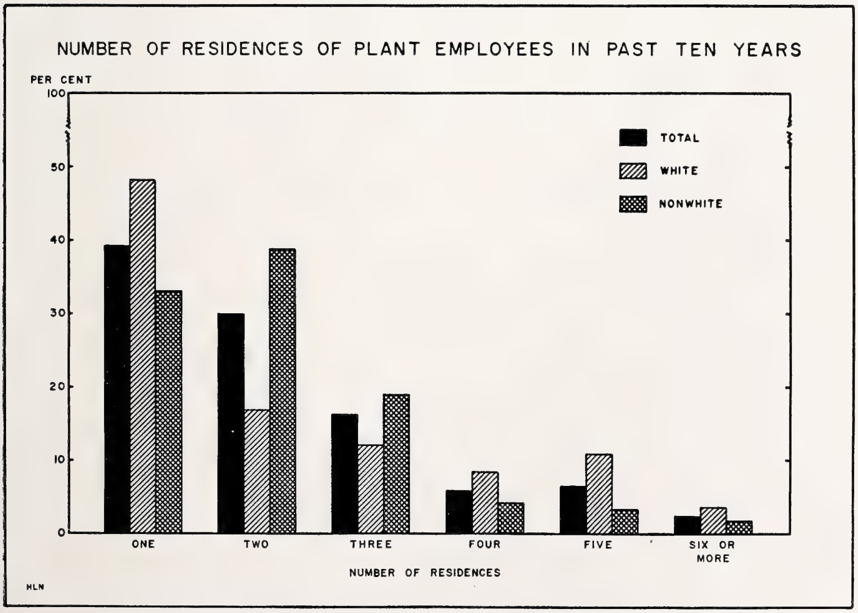


FIGURE 4.

These findings suggest that mobile persons are more likely to seek industrial employment. However, it is impossible to determine whether such employment is causally related to migration.

The majority of last moves of respondents did not involve a change in residential classification. The nature of the last move of interviewees having moved within the past 10 years is shown in Table 3. Both employees of the Roseland plant and nonemployees, among the movers in the sample population, were prone to move from one farm to another, one town to another, or one open-country residence to another. It might be expected that factory employment would entice a large proportion of the workers to move from farms and other open-country residences to towns and cities, but this was not the case.

The tabulations indicate that 37 per cent of the last moves made by Roseland factory workers were from one town to another town, whereas 17 per cent were from one farm to another farm, and 17 per cent from one open-country residence to another. Only 7 per cent left farms, and only 4 per cent left rural-nonfarm dwellings for city or town residence.

Open-country interviewees with a history of migration were more likely to have moved from another open-countrv residence, although 29 per cent of those having moved had lived in a town or city previous to their last move. Over one-third of the persons in this group made a move from one farm to another farm, and 17 per cent moved from one open-country nonfarm residence to another. A few, 8 per cent of those having moved, left a rural-nonfarm residence to live on a farm.

TABLE 3.—Type of Last Move of Interviewees[1] Having Moved in the Preceding 10 Years

Last Move	Open Country		Plant Empoyees	
	Number	Per Cent	Number	Per Cent
Farm to farm	40	35	21	17
Farm to open-country	13	11	11	9
Farm to town or village	—	—	8	7
Open-country to farm	9	8	4	3
Open-country to open-country	20	17	21	17
Open-country to town	—	—	5	4
Town to farm	19	16	3	2
Town to open-country	15	13	5	4
Town to town	—	—	46	37
Total	116	100	124	100

[1] Includes only those moves occurring in period 1947-1957.

The remainder (11 per cent) moved from a farm to a non-farm residence in the open country.

Interviewees made their last move for a variety of reasons, chief among which was the desire to live in their own house. However, many plant employees had moved to get closer to their work. Other reasons mentioned by both groups for moving were: "to live with or be closer to relatives," "forced out of old home," "cheaper," "needed more room."

The most recent moves of interviewees were short-distance moves. Of the persons moving in the past 10 years, more than two-thirds of the most recent moves of open-country, non-employee residents and three-fourths of the last moves of Roseland plant employees did not involve the crossing of a parish boundary. By contrast, only 9 per cent of the open-country respondents and 14 per cent of the plant employees had moved to their present location from another state. These data seem to indicate that rural persons do not tend to move long distances when they migrate. It also implies that a rural industry must plan to recruit the majority of its personnel locally.

OCCUPATIONAL CHARACTERISTICS AND MOBILITY OF INTERVIEWEES

Because of the general inexperience of rural persons in industrial work, it may be hypothesized that: (1) employees of a factory located in a rural area would have a more extensive history of occupational mobility than the average rural resident in the same area; (2) workers recruited from rural areas would be assigned the unskilled and semi-skilled jobs; and (3) the usual conditions and pay of industrial work would appear attractive to rural persons. The data collected which pertain to these hypotheses are presented in the following discussion.

Employees of the Roseland plant were in unskilled and semi-skilled work for the most part. Only 6 per cent of the employees interviewed held managerial, clerical, or kindred positions, and only 1 per cent (three persons) were employed as protective and service workers. Just about one-half of the employees were classified as unskilled laborers. These persons were either general laborers, helpers, or board and cleat layers. The remainder (44 per cent) were identified by the plant management as holding skilled or semi-skilled jobs, although it was determined by observation that the majority of this group were doing semi-skilled work.

A statement regarding the jobs which women and Negroes filled is warranted, since the Roseland plant employed a considerable number of both. A few white women were employed as clerks, but the remainder of the women of both races were in unskilled or semi-skilled jobs. Taken as a group, Negroes were employed to a much larger extent (relatively) as unskilled laborers than were whites. No Negro was employed as a clerk, watchman, or supervisor.

These findings have significance for the major objective of this study. They indicate that industries with a high demand for unskilled laborers are likely to have greater success in rural areas.

Employees of the Roseland plant changed jobs more frequently than the average rural person interviewed. This finding has implications for rural industry because it indicates a greater willingness or ability of employees to change jobs. All but 13 of the workers in the box factory had had more than one job during the last 10 years. In contrast, only half (52 per cent) of the non-employee, open-country interviewees had held more than one job during this time. Almost three-fourths of the employees queried had worked in two or three different jobs, but only one-third of the nonemployees interviewed had changed occupations this much. One out of every five of the employees had held four or more jobs, but just one out of every ten of the nonemployees interviewed had held at least four different jobs in the past decade. (See Table 4.)

The reasons for the above patterns are not clear. Possibly the higher occupational mobility of plant employees is related to their availability for off-farm employment. It is certainly true that fewer of them owned farms, and it is evident they have a wider variety of work experience than the average rural person.

Nonwhite and white employees showed little difference in employment stability. However, there was a tendency for Negroes to be con-

TABLE 4.—Number of Jobs of Interviewees Since 1947

Number of Jobs	Open-Country		Plant Employees	
	Number	Per Cent	Number	Per Cent
One	147	48	13	7
Two	62	20	81	40
Three	37	12	65	32
Four	16	5	29	14
Five	8	3	9	4
Six or more	4	1	7	3
Retired or unable to work	25	8	—	—
Not applicable	8	3	—	—
Total	307	100	204	100

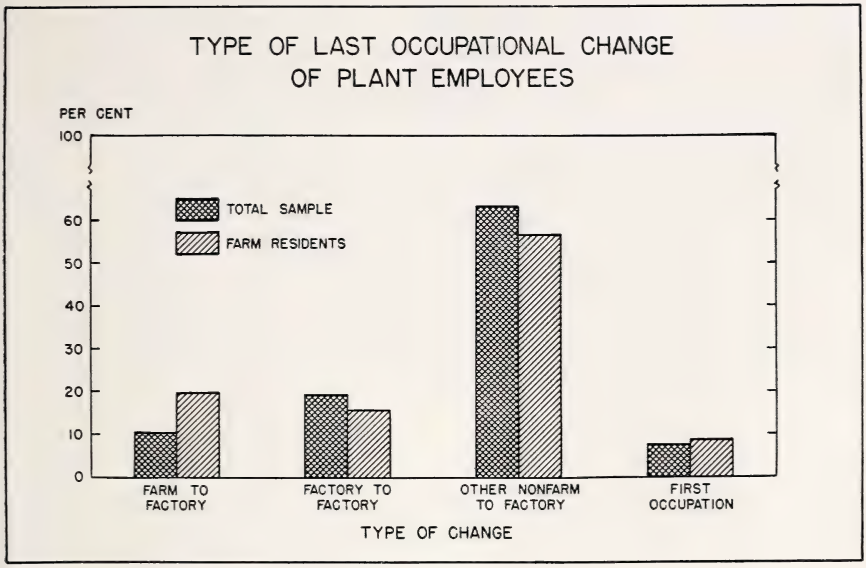


FIGURE 5.

centrated at the extreme positions on the occupational mobility scale; i.e., relatively more of them made no moves and relatively more of them made four or more moves.

Most factory employees shifted from other non-farm work to take their present jobs. Only 10 per cent of the employees interviewed made a direct change from farm work. Almost one-fifth (19 per cent) of them shifted from another factory job and more than three-fifths

TABLE 5.—Type of Last Job Change Reported by Interviewees

Type of Change	Open-Country		Plant Employees	
	Number	Per Cent	Number	Per Cent
Farm to farm	13	4	—	—
Farm to factory	3	1	21	10
Farm to nonfarm	23	7	—	—
Factory to factory	—	—	39	19
Factory to other nonfarm	2	1	—	—
Other nonfarm to farm	27	9	—	—
Other nonfarm to factory	6	2	129	63
Other nonfarm to other nonfarm	37	12	—	—
Retired	54	18	—	—
First job	3	1	15	8
Not applicable	138	45	—	—
Total	307	100	204	100

(63 per cent) came from some other type of non-farm work. Fifteen persons (8 per cent) were on their first job. (See Figure 5 and Table 5.)

Most interviewees had no formal job training of any kind. Approximately four out of five persons queried in both the employee sample group and the open-country sample group said that they had no formal training for either farm or non-farm jobs. Of the remaining 20 per cent, the largest number had received training through one of the G. I. technical schools set up after World War II. Since these schools are no longer in existence, it is likely that fewer persons in low-income rural areas will have formal job training in the future. Those persons who get such training will likely receive it in a high school, college, or a state supported vocational school. (See Table 6.)

Nonfarm work had little effect on farm tenure and mobility. Some 37 of the 68 plant employees residing on farms reported they owned their farms. Thirteen said they were part owners. The remaining 18 were renters of one kind or another. Significantly 38 of the 68 farmers had been on the same place at least 10 years. Another 13 had lived from 5 to 9

TABLE 6.—Farm and Nonfarm Job Training of Interviewees

Job Training	Open-Country		Plant Employees	
	Number	Per Cent	Number	Per Cent
Training in farming practices				
High school	16	5	8	4
Vocational school	—	—	1	1
G.I. training classes	36	12	15	7
On-the-job training	2	1	2	1
College	3	1	1	1
Other	6	2	9	4
None	244	79	168	82
	307	100	204	100
Nonfarm job training				
High school	1	*	5	3
Vocational school	11	4	11	5
Night school	1	*	3	2
On-the-job training	17	6	22	11
Armed forces	12	4	11	5
College	13	4	1	*
G.I. training classes	3	1	1	*
Other	5	2	5	3
None	244	79	145	71
Total	307	100	204	100

*Less than 1 per cent.

years on their present farms. The remainder had been on their present places fewer than 5 years.

Three-fourths of the 217 open-country families living on farms were full owners and another 11 per cent were part-owners. These percentages may seem fairly high, but they are typical of the family farm areas in this part of Louisiana. Only 14 per cent of the open-country families were renters. One-half (104) of the 217 open country families on farms had lived on and operated their present farms for at least 10 years. Another 37 had been on their farms from 5 to 9 years. Just 42 had a residence history of fewer than 5 years on their present places.

Two significant facts stand out in the above data. First, those persons who are on farms are likely to be owners or part-owners and therefore have a strong tie with their present residence. Second, farmers in this area generally have a long residence history at their present places. These facts are important in that they suggest that farmers in areas such as the study area would not be likely to migrate in search of nonfarm work.

INTERVIEWEES' FEELINGS ABOUT INDUSTRIAL WORK

Rural people might be expected to have definite opinions about the relative advantages of farm and nonfarm work. These opinions would certainly condition their acceptance of industrial employment. For example, the fact that factory work generally involves more regimentation and supervision at the same time that it invites monotony—factors somewhat foreign to the agricultural way of life—could be expected to produce attitudes unfavorable to such work. For this reason certain questions were designed to determine interviewees' feelings about industrial work. The responses to these questions are described below.

Rural persons with nonfarm work experience had a slight preference for such work. In an attempt to probe more deeply into the feelings of rural residents about farm work and thus develop insights into their future behavior, each interviewee with farm experience, but who was working at a nonfarm job, was asked to compare the two types of work.

Plant employees were favorable to industrial employment but not overwhelmingly so. Of the 37 employees living on a farm and who had done farm work, 22 gave answers judged to be more favorable to their present nonfarm employment. The advantages which most of them stressed were the higher and more regular pay. They also said the work was not so hard, the hours shorter, and the work generally more attractive.

Fifteen of the 37 employees preferred farm work. Their comments indicated they thought factory work was harder, they didn't like to be "bossed," and they liked working in the open and with living, growing things.

Open-country residents living on farms and also working at nonfarm jobs reacted in approximately the same way as plant employees. Of the 25 persons in this group, 14 favored plant work and 11 favored farm work. The reasons given for their preference were essentially the same as those given by plant employees in both instances.

Farmers generally had not sought nonfarm jobs. Open-country residents living on farms and not engaged in nonfarm work were asked if they had made an attempt to get off-farm employment during the past year. This question was designed to shed light on their migration potential, as well as their availability for industrial employment. Of the 141 individuals to whom this question applied, 38 said they had considered such employment, but only 18 had actively sought such a job. Ten of the latter had not looked beyond their immediate parish, while eight had gone as far as the adjoining parish. None had crossed a state line in search of work.

Most of the employees seeking outside jobs had found no opportunity available. Of those finding opportunities, most didn't take the job because it didn't pay enough, or they felt they had to travel too far to work. In the light of these findings, it seems that rural industries will have more success recruiting laborers if they locate as near the population center of rural communities as possible.

Interviewees with nonfarm work experience differed from respondents with only farm experience in what they considered the most desirable job conditions. The former ranked "steady work" and "high pay" as the most important job conditions, while the latter felt that a "safe, clean place" to work and "good hours" were most desirable. (See Figures 6 and 7.) The difference in response between the above two groups is understandable in the light of their different experiences. Persons with industrial employment experience take an 8-hour day for granted, and know that certain types of industrial work is as dirty and hazardous as farm work can be. It is significant that the same pattern of responses held for both Negro and white interviewees in the two sample groups. The above findings suggest that rural persons hold a "glamorized" stereotype about industrial employment conditions, which might be conducive to their seeking such employment, initially at least.

Plant employees living on farms planned to continue farming at the same level. Of the 36 persons living on a farm and who did farm work prior to their factory job, 25 had no thought of changing their farm operation. Only one planned to give up farming. Five actually planned to increase their farming activity and five expected to reduce their scale of operation somewhat.

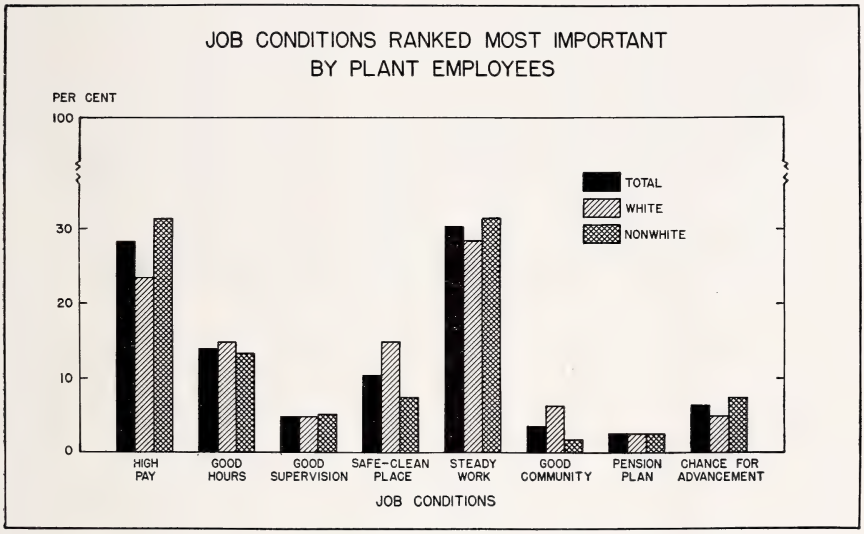


FIGURE 6.

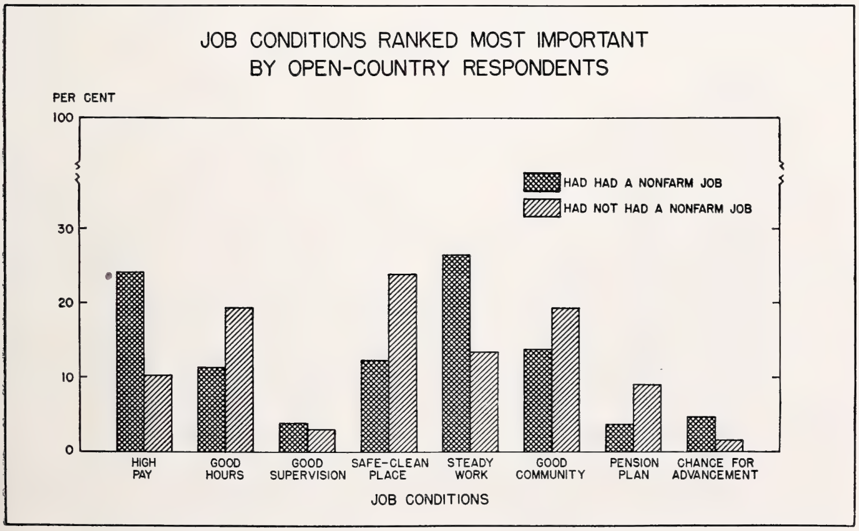


FIGURE 7.

Most open-country families living on farms with one or more of their members doing nonfarm work also planned to continue farming. Almost 9 of every 10 of this group said they expected to stay on the farm. Their reasons for this decision differed somewhat. Some stated they didn't know how to do anything else, others said they were too old to take up something new, but most said they loved farming. One senses from the latter statement that farming is more than an occupation for many rural dwellers in this area—it is a way of life.

Some 12 farm families in the open-country sample were undecided as to whether or not they would continue farming and five definitely planned to give it up. Two of the latter just didn't care for the type of life and the other three said it was too hard to make a living by farming.

IMPACT OF RURAL INDUSTRY ON THE LEVELS OF LIVING OF INTERVIEWEES

A major aim of the Rural Development Program is to improve rural levels of living. Rural industrialization has been suggested as one way depressed rural areas might get a needed economic boost. The impact on level of living of industrialization is reported in this section. Each person interviewed was asked several questions relating directly to changes in his level of living in recent years. In reviewing these responses, it should be noted that a few employees had only a short work history at the box factory, and a few open-country respondents had not lived in the area for a long period of time. Nevertheless, the responses given reflect the impact of the Roseland plant for this period and are significant to this study.

Ownership and use of specified facilities and equipment has increased since the Roseland plant began operation. Each interviewee was questioned directly about the presence of the following items in his home in 1950 and 1957: electric lights, hot and cold running water, mechanical refrigeration, power washing machine, radio, television, and telephone. The changes in the number of these facilities owned between the earlier and the later date are shown in Figure 8 and Figure 9. There has been a substantial increase in the presence of these items in the homes of interviewees. The change is significant enough to indicate that the general level of living of the average resident in the sample area has risen quite rapidly since 1950. For illustration, more than one-fifth (25 per cent) of the plant employees and 17 per cent of the nonemployees interviewed did not have any of the inventoried items in their homes in 1950. In the light of the fact that rural levels

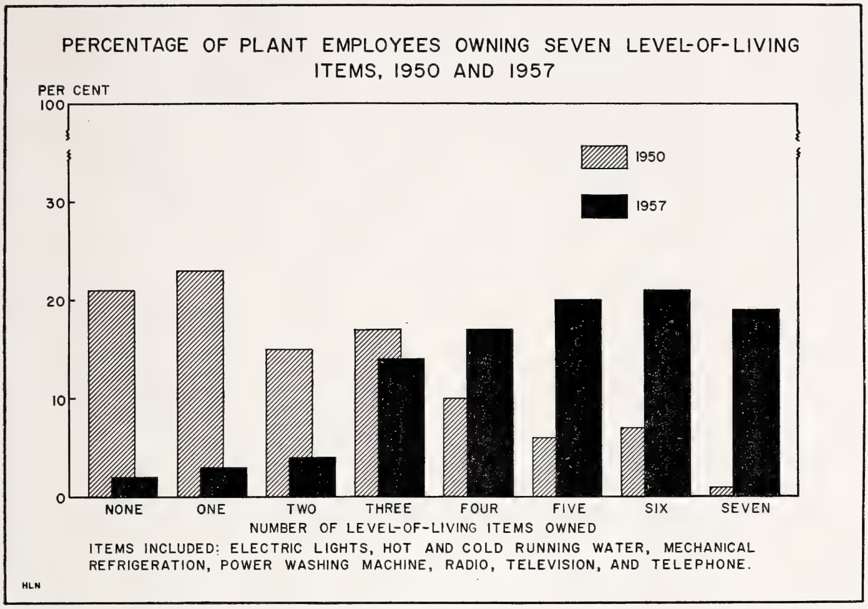


FIGURE 8.

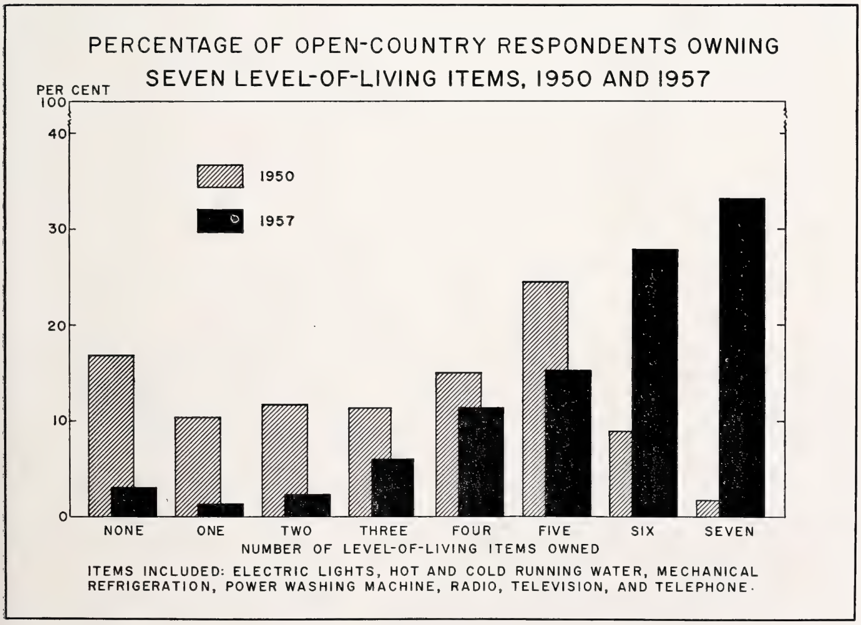


FIGURE 9.

of living have been rising generally, it is certain that some items were acquired by the families of interviewees before they began work at the plant. At the same time, it is clear that many of them, especially employees, could not afford certain items before they began work and were more or less assured of a steady income. The fact that open-country respondents have slightly higher levels of living may be explained by the fact that they were older and had more opportunity to accumulate the items. It is pertinent in this connection that the number of level-of-living items owned by plant employees increased 110 per cent from 1950 to 1957, whereas the number of items owned by open-country respondents increased by 75 per cent.

The improved levels of living of plant employees since 1950 is shown more vividly in connection with their ownership of automobiles. Fifty-nine (29 per cent) of the 204 employees interviewed owned a car at the time of the interview, but did not in 1950.

Employees felt the plant contributed materially to improved levels of living. In an attempt to go beyond objective criteria, each employee interviewed was asked if he thought the factory had helped his community. The vast majority (96 per cent) stated that the plant was primarily responsible for the higher levels of living in the community within the past few years. Most employees (65 per cent) said that the factory had improved levels of living by providing work and steady income for local people. Some (13 per cent) went so far as to state that the factory was the only thing that "kept the community alive."

A significant number of interviewees believed their chances to get ahead have improved in recent years. Levels of living are closely related to opportunities for "getting ahead" in the sense in which this term is used in rural areas. Thus each respondent was asked if he thought the chances of a person's getting ahead were better, the same, or worse than five years ago. Fifty-four per cent of the plant employees and 39 per cent of the nonemployees interviewed believed chances for getting ahead were better. The main reasons given for making such a statement were: "more job opportunities" and "better wages." Only 7 per cent of the employees and 23 per cent of the nonemployees felt that the chances to get ahead were worse than five years ago. The main reason given for such negative responses was the high cost of living. The remainder of both groups felt that chances were about the same.

The above data show an interesting tendency for the nonemployee respondents to be less convinced that times were better. Their age characteristics and the fact that they were not employed at a steady job, for the most part, probably accounts for their answers.

Whites and nonwhites working at the plant differed little in their opinions. The majority of both racial groups felt that the chance to get ahead had improved. There was a marked difference between the responses of the whites and nonwhites in the nonemployed sample, however. A considerably larger proportion of the nonwhites than of the whites felt that the chance to get ahead was better. This may be a reflection of the general improvement in the conditions of the nonwhites over the past several years.

Income of employees on farms has increased materially. It will be recalled that just one-third (68) of the employees resided on farms. All but four of the farms on which employees lived were being operated.

Each interviewee living on a farm was asked about changes on the farm made since he began working at the plant. More than three-fifths (62 per cent) of them reported no change in farm operation. The rest of the group living on farms said there had been certain changes, mostly decreases in cultivated acreage or in herds or flocks. A few had substituted an enterprise requiring less care for one requiring more constant attention. Only one individual stopped farming completely.

Considering the above findings, one can readily see that plant employment means better levels of living for farmers on low-income farms. It usually is possible to maintain the income of the farm at the same time that one member of the family takes off-farm work. It may be noted that employees who lived in rural areas but did not farm also improved their incomes by taking their plant jobs. Both these findings have significance for the Rural Development Program.

IMPACT OF INDUSTRIALIZATION ON SOCIAL PARTICIPATION

One of the aims of this study was to examine the trends in social participation of interviewees, and to ascertain if changes had been occasioned by plant employment. The hypothesis posed was that industrial employment would bring new associations and, as a consequence, new opportunities for social participation.

Interviewees did not participate in a wide variety of formal organizations. This pattern is according to expectations regarding social participation in a low-income rural area. It may be seen in Table 7 that the largest percentage of plant employees (59 per cent) and nonemployees (45 per cent) were active in religious organizations only. Nineteen

TABLE 7.—Type of Formal Participation of Interviewees

Type of Participation	Open-Country		Plant Employees	
	Number	Per Cent	Number	Per Cent
No membership	45	15	35	17
Membership, but inactive	17	5	4	2
Active in religious organization only	137	45	121	59
Active in secular organization only	19	6	6	3
Active in both religious & secular org.	89	29	38	19
Total	307	100	204	100

per cent of the former and about 29 per cent of the latter were active in both a religious and secular organization. A few persons in both sample groups (3 per cent of the employees and 6 per cent of the nonemployees) were active only in secular organizations. The remaining persons in both groups, approximately one-fifth, either held no membership or were totally inactive in formal organizations.

The social participation of interviewees was not high. An index was constructed to determine the degree of social participation of informants as follows: Each person was scored by allowing one point for membership, two points for regular attendance, and three points for being an officer or committee member. Respondents' score were summed to get their index rating. The percentage distributions of scores for the two sample populations are shown in Table 8. As may be seen, the median participation score was 3.04 for employees and 2.56 for the open-country sample group. Plant employees thus appear to be slightly more active than the average rural person. The age and racial differences in the composition of the two groups could well account for this fact.

The majority of the interviewees felt that social participation had not increased in the past five years. When asked to compare their or-

TABLE 8.—Index of Degree of Social Participation of Interviewees

Social Participation Score	Open-Country		Plant Employees	
	Number	Per Cent	Number	Per Cent
None	45	15	35	17
One point	95	31	59	29
Two points	24	8	6	3
Three points	70	23	57	28
Four points	35	11	13	7
Five points	10	3	9	4
Six points or more	28	9	25	12
Total	307	100	204	100
Median degree of participation	2.56		3.04	

ganizational activities at present with their organizational activities five years ago, 43 per cent of the plant employees and 49 per cent of the nonemployees said that little change had occurred. Those persons saying their participation had increased (34 and 23 per cent) explained they now had more interest in and more time for outside activities. Significantly, the nonemployee sample group reported less increase in social participation than the employee group. This fact would seem to indicate that industrial employment serves to increase participation.

A larger percentage of nonwhites in both sample groups said that their social participation is greater now than before. This fact is further evidence that plant employment means more from a social participation standpoint, for this racial group. (See Table 9.)

TABLE 9.—Comparison of Degree of Present and Past Social Participation of Interviewees

Present Social Participation Compared to Past	Open-Country		Plant Employees	
	Number	Per Cent	Number	Per Cent
Same	149	49	88	43
Greater	72	23	68	34
Have more time to participate	6	2	4	2
Better able to participate	2	1	3	1
More interested, attend more	57	18	45	23
Other	4	1	6	3
No comment	3	1	10	5
Less	48	16	19	8
Too tired (after work), too old	22	7	2	1
Don't have time	7	2	5	2
Less interested now	8	3	5	2
Other	10	3	5	2
No comment	1	1	2	1
Not applicable	38	12	29	15
Total	307	100	204	100

Industrial employment apparently did not greatly affect leisure time activities of rural persons. Almost 57 per cent of the employees interviewed stated that there was little difference in their use of leisure time since taking a factory job. More than one-fourth (28 per cent) had made one substitution in the types of leisure activities in which they engaged. One out of every eight had made two substitutions and a few (3 per cent) had made three or more substitutions.

Television and/or radio use had increased as a leisure time activity, as had reading, visiting, resting, and just working around the house. In contrast, participation in sports, movies, and sewing had decreased. Apparently, plant employment serves to keep the employees at home more. This is understandable in terms of their being away from home during work hours. The major leisure activities of the plant employees are hunting, fishing, visiting, and resting.

It should be noted that the leisure activities of the nonwhite employees have been changed more by plant employment than those of white employees. This may be related to the differential gain in income of the former group.

THE IMPACT OF INDUSTRIALIZATION ON COMMUNITY LIFE

One of the major purposes of this study was to determine what effect industrialization would have on a rural community. It was hypothesized that certain community institutions would be affected to a considerable degree. Accordingly, all interviewees were asked whether the establishment and operation of the Roseland factory had had an impact on community schools and churches. The persons interviewed were also asked whether or not they felt that neighborliness, community pride, and the opportunity to get ahead had changed since the coming of the factory. Findings relating to these questions are discussed in this section.

Interviewees were of the firm opinion that schools have improved in the past five years. Almost 70 per cent of the nonemployee sample group and 65 per cent of the Roseland factory employees said that schools had improved since the plant began operation. (See Figures 10 and 11.) Respondents frequently mentioned improved facilities (better buildings, better instructional equipment, etc.), better teachers, and better curricula in backing their contention that the schools had improved.

Only 6 per cent of the open-country nonemployee respondents and only 4 per cent of the employees felt that schools had changed for the worse. These persons backed their opinion with reference to poorer teachers or curricula, over-crowding, and the feeling that children were not learning as much as they had in the past.

Racial breakdown of the data collected reveal some interesting differences in opinions between white and Negro employees. Of the Negroes, 71 per cent felt that schools had changed for the better. An affirmative response was given by only 57 per cent of the white interviewees. Since there was little diffierence in opinions concerning

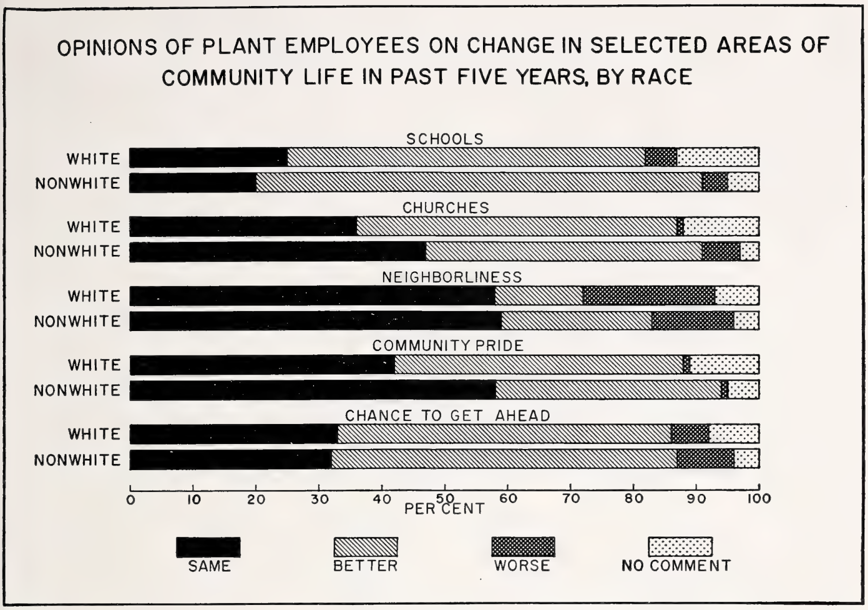

OPINIONS OF PLANT EMPLOYEES ON CHANGE IN SELECTED AREAS OF COMMUNITY LIFE IN PAST FIVE YEARS, BY RACE

FIGURE 10.

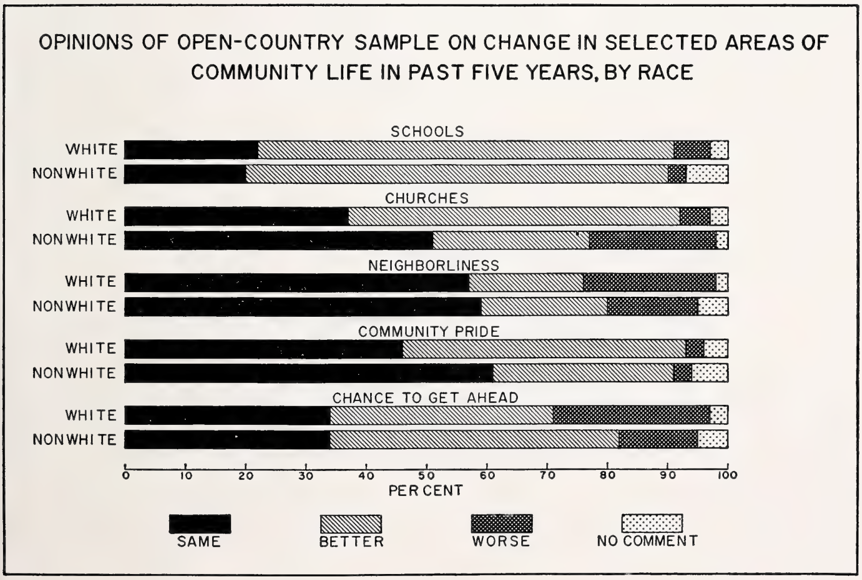

OPINIONS OF OPEN-COUNTRY SAMPLE ON CHANGE IN SELECTED AREAS OF COMMUNITY LIFE IN PAST FIVE YEARS, BY RACE

FIGURE 11.

schools in the nonemployee, open-country sample population, an interesting explanation is suggested. It is probable that both rural and Negro schools have improved relatively more than urban schools within the past few years. This phenomenon would account for the pattern of response received.

The role of the factory in the improvement of schools is difficult to measure. Certainly its impact has been more indirect than direct in nature. However, by increasing personal and tax income in the area, the factory would certainly benefit the schools.

There was a strong consensus that churches in the community have improved. Approximately half of both sample groups said that commuty churches had changed for the better in the past five years. Interestingly, rather large percentages of both sample groups opined that churches were about the same. It is quite probable that this group represents the nominal church goers. The two sample groups differed in their explanations of why they thought community churches had improved. Plant employees cited improved facilities as the major change, while interviewees not working at the plant said better attendance was the chief improvement.

Some 9 per cent of the respondents not working at the plant and 4 per cent of the plant employees said that the churches had lost ground in recent years. The major reason cited for this comment was poor attendance and a demand for "too much" money.

Some interesting racial differences of opinion are evident in the data collected. Relatively more of the white interviewees than of the nonwhite interviewees said that community churches had improved. This pattern held true in both sample groups. The explanation for this phenomenon is not clear. It may be that the nonwhites' traditional church patterns are not affected greatly by the economic base.

Interviewees felt that neighborliness is about the same now as before the coming of the plant. In reply to the question of whether neighborliness had changed for the better, the worse, or had remained about the same, almost two of every three interviewees said that very little change had occurred. Approximately one out of every five persons interviewed actually felt that people were more neighborly than before. Nearly the same number were convinced people were not as neighborly, saying people were too busy or watched television too much to visit.

Approximately two out of every five interviewees felt that community pride had improved in the past five years. These persons said they noticed home and yard improvements, better roads, and more facilities.

Significant differences appeared in the responses of the whites and nonwhites in the sample groups. The nonwhites were more firmly of the opinion that little change had taken place in community pride. Whites were more assured that community pride had improved.

Again, there is indication that the factory has had an effect upon the community. That the change has not been radical is apparent. The effect has been more of an economic and of an individual nature and has not been great enough nor accumulative enough to carry over to everyone in the community.

A Note on Community-Factory Relations

Recent developments in the community studied provide an opportunity for further insight into the rural industrialization picture. In openly stating they were planning to move from the community, plant officials cited difficult local conditions as their reason.

Informal interviews with the plant manager and the leaders in the village where it was located had indicated a strained relationship at the time of the study. Local government officials contended that the "factory" had never identified itself with the community nor concerned itself with community affairs. They especially resented the fact that factory management never went through community channels when making decisions affecting the local people. In this regard, they pointed out that the majority of the management personnel and most of the office staff lived outside the community and took no part in local activities. On the other side of the coin, the plant manager felt that the plant was the sole support of the community and deserved more support from it than it had been receiving. He stated the community had not been "receptive" to the plant.

Although the apparent focal point for the strained relations between plant and community officials was a dispute over taxes, this is not the concern nor interest of the present study. The significant facts are that (1) rural industry cannot hope to succeed without local good will, and (2) rural communities cannot hope to attract and hold industry without some concession. With reference to the former, it is clear that an industry, to be accepted, should use local channels for communicating decisions involving the community and must participate to a greater or lesser extent in community life. On their part, rural community leaders need to recognize that industrial officials, by virtue of their charge to run their plants efficiently and to show a profit, must make decisions in the light of economic operation. Local persons, with rural values and accustomed to familial type decisions and authority, will need to understand and allow for the factors operative in industrial decision making.

The above note should be of special interest to Rural Development Program officials and other planners for rural areas. It appears to the writers that the information is of vital concern if industrialization projects are to succeed.

Pine Planting and Profits In North Louisiana

lletin No. 525 June 1959

Louisiana State University
and
Agricultural and Mechanical College
Agricultural Experiment Station
Charles W. Upp, Director

Questions and Answers on Planting of Loblolly Pine

Questions	Answers
1. Will pine planting be profitable?	1. Generally, yes.
2. What is the cost of planting an acre?	2. From $4 to $15 on open sites.
3. What are the annual maintenance costs?	3. About $1.27 per acre covers management and taxes.
4. When can first returns be realized?	4. In about 15 years.
5. What returns can be expected?	5. Pulpwood at 25 years probably will gross $182, for a net return of $4 to $5 per acre per year. Sawtimber at 40 years probably will gross $400, for a net return of $8 per acre per year.
6. What is the rate of return from pine production?	6. This depends upon cost structure and time of harvest, but calculations based upon study data indicate a possible range of 4.6 to 12.4 percent.
7. What rotation is suggested?	7. Pulpwood—25 years. Sawtimber—40 to 60 years.
8. How much can one afford to spend for site preparation?	8. Site preparation in excess of $50 per acre will probably cancel out anticipated profits.

TABLE OF CONTENTS

Page
Questions and Answers 2
Introduction and Objectives 4
Growth Characteristics and Thinning 4
Future Demand, Supply, and Price 7
    Estimated Future Demand 7
    Estimated Future Supply 8
    Estimated Future Prices 9
Planting and Management Costs 10
Value of Planted Pine Stand at Various Ages 12
Estimated Returns for Pulpwood and Sawtimber 14
Estimated Net Annual Returns 15
The Most Profitable Rotation 21
Summary and Conclusions 23
Appendix 26
    Procedure 26
    Sources of Data 26
    Tables 27

Acknowledgments

Basic information for this report was obtained from numerous sources. The authors acknowledge the information received on costs and management through consultation with foresters engaged in industry and forest research. The authors are particularly grateful to R. W. McDermid and his associates, School of Forestry, Louisiana State University, for providing basic growth data essential for the success of this study, and for suggestions resulting from a review of the manuscript.

Photographs were provided by the Louisiana Forestry Commission.

Pine Planting and Profits in North Louisiana

By F. L. Corty and J. J. Stevens*

INTRODUCTION AND OBJECTIVES

Before making an investment of any kind, one normally studies the outlook for the future to see whether the investment is likely to be profitable. If, after studying costs, returns and alternative possibilities, the investment appears sound and profitable, most individuals proceed to put time and money to work.

Many people who own land in North Louisiana are faced with the problem of whether to invest time and money in reforestation or to use their resources in some other way. Many farms in North Louisiana have fields lying idle waiting to be put to some profitable use. The purpose of this bulletin is to examine the profitability of establishing pine plantations on old field sites, and to point out certain current trends that may affect planting decisions. The procedures followed in developing the data for this report and the sources of information are given in the Appendix.

GROWTH CHARACTERISTICS AND THINNING

At some point in the future it may be feasible to grow timber by more intensive methods through such practices as irrigation, fertilization, or the use of hormones. The Hill Farm Experiment Station at Homer, Louisiana, has already started work that will help indicate what the maximum growth rate for loblolly pine can be, but within the near future it is unlikely that growth rates will vary appreciably from growth rates for previous years. Thus, in this report it is assumed that future growth can be predicted fairly accurately from past yields. The number of trees, size, volume, and the rate at which an acre of loblolly pine will grow are given in Table 1. Yields of a planted stand have been estimated on the basis of the growth observed in planted test plots, and in older natural stands.

The desirable rate of thinning in a pine plantation has been for years a choice subject for discussion. This bulletin makes no attempt to solve this question, but assumes that management practices as recommended by the School of Forestry, Louisiana State University, are to be followed.

---

*Assistant Professor and former Associate, respectively, Department of Agricultural Economics.

TABLE 1.—Average Growth Characteristics and Value of an Acre of Planted Loblolly Pine in North Louisiana

	Trees		Diameter Breast High	Total Height	Volume of Timber			Estimated Value of Stand
Years	Cut	Leave			Thinning	Remaining	Total	
	(No.)		(Inches)	(Feet)	(Pulpwood-Cords)			(Dollars)
15	190	450	5.4	29	5.1	12.1	17.2	68.80
20	110	340	6.6	39	5.9	18.2	24.1	102.42
25	90	250	7.9	49	8.5	23.6	32.1	136.42
30	60	190	9.2	58	8.3	26.3	34.6	147.05
35	40	150	10.5	64	7.8	29.2	37.0	157.25
					Volume of Sawlogs (Board Feet-Doyle Rule)			
40	30	120	11.8	70	1,676	6,704	8,380	251.40
50	50	70	14.2	80	6,241	8,737	14,978	449.34
60	40	30	16.6	86	8,672	6,504	15,176	455.28
65	24	6	17.7	88	6,414	1,603	8,017	240.51
70	6	0	19.0	90	2,010	——	2,010	60.30

*Prices: Pulpwood at 15 years of age, $4.00 per cord, and $4.25 for subsequent years. Sawlogs at an average of $30 per thousand board feet—Doyle Log Rule.

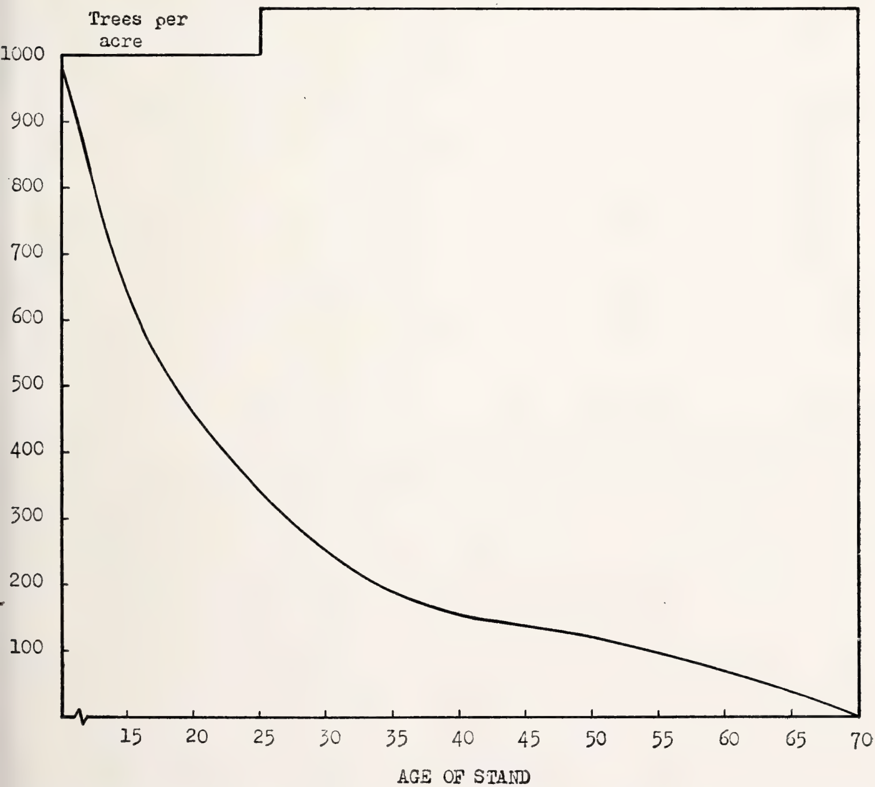


Figure 1.—Number of Trees Per Acre at Various Ages for a Planted Stand of Loblolly Pine.

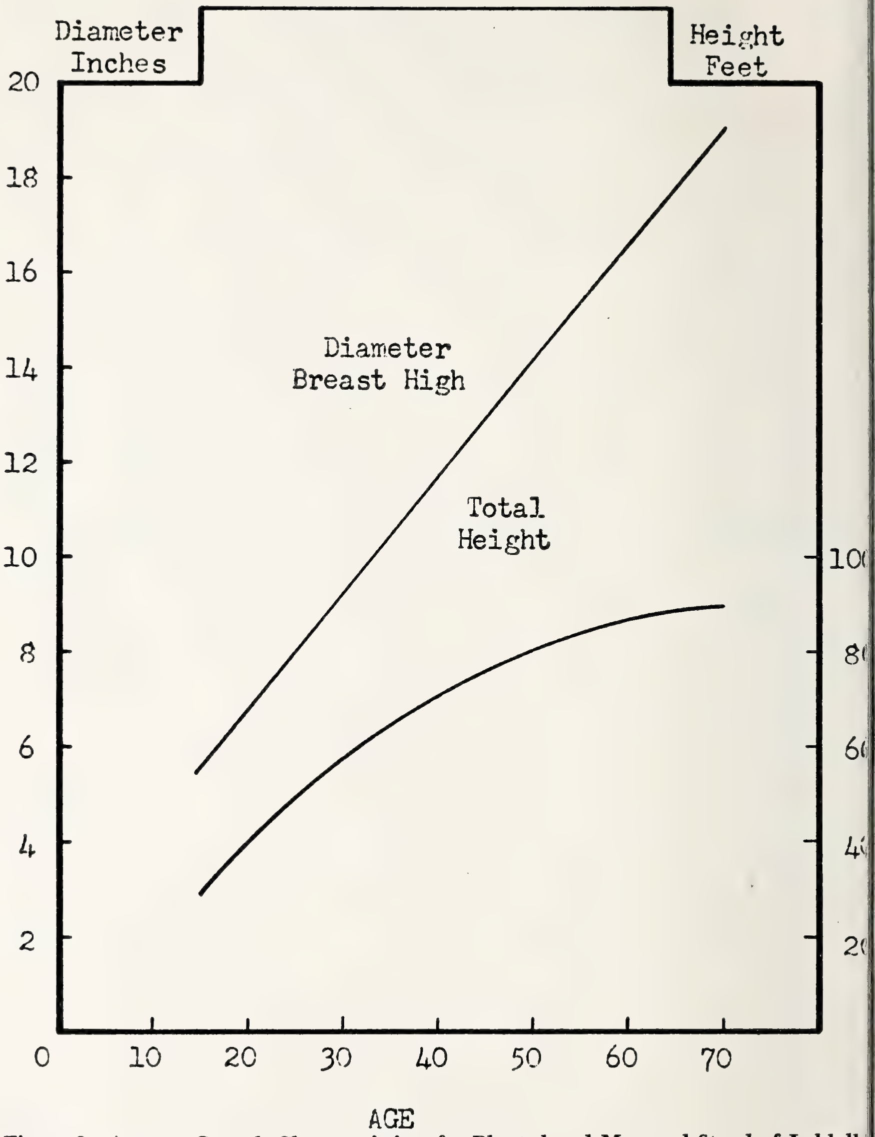


Figure 2.—Average Growth Characteristics of a Planted and Managed Stand of Loblol
Pine.

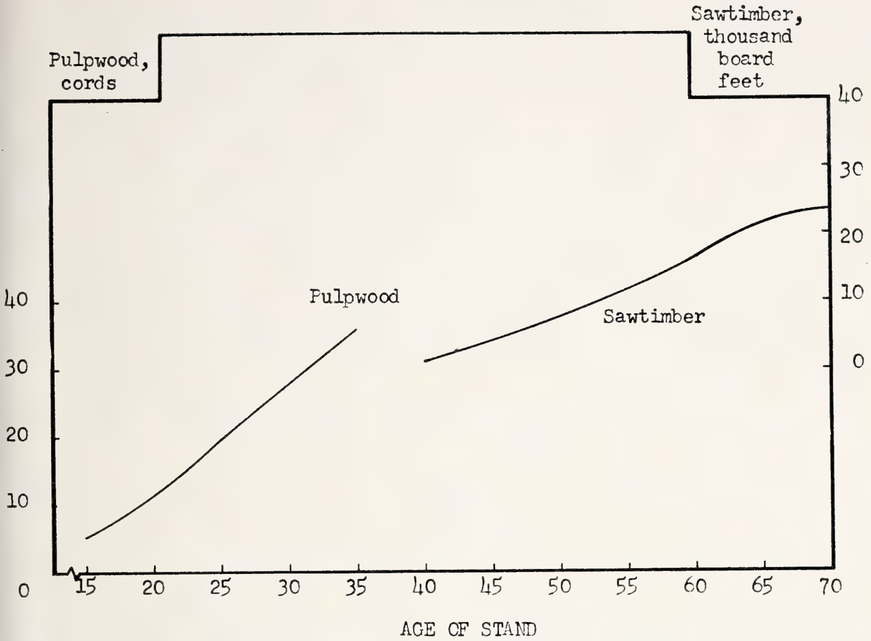


Figure 3.—Accumulated Yield of Pulpwood and Sawtimber (Doyle Rule) Per Acre of Managed Loblolly Pine.

FUTURE DEMAND, SUPPLY, AND PRICE

To accurately predict costs and prices for 50, 25 or even 15 years hence would require the insight of a prophet. Nevertheless, this report would fall short of its intended objective if it merely reported the present cost-price relationships and failed to provide outlook information which could serve as a basis for making decisions about tree planting today with the hope of realizing returns 15 to 40 years later.

For this future outlook the authors rely almost entirely upon a comprehensive report known as the "Timber Resource Review."[1] This review contains a very detailed appraisal of timber resources for the future.

Estimated Future Demand

Appraisals contained in the "Review" were based upon the following assumptions:[2]

1. Peace, but continued military preparedness.
2. A rapid rise in population.
3. Economic prosperity and high living standards as reflected in a much larger gross national product.

---

[1] *Timber Resources for America's Future, Forest Resource Report No. 14,* Forest Service, USDA, January 1958.

[2] *Ibid.,* p. 7.

4. Continued importance of forest products as a basic raw material.
5. Continuation of present improvement trends in forestry.

In light of the above assumptions, projections of demand for timber were made for the years 1975 and 2000. Three sets of projections were made for each of the future periods. A basic or medium projection was designed to reflect an intermediate rate of future national economic growth. Upper and lower projections were variants from the medium. In general, both medium and upper projections were based on assumptions that industrial timber products will occupy about the same relative economic role as they do at present. In contrast, the lower projection assumed higher relative prices and a declining role for wood in the future economy of the nation.

The key assumptions for projections of timber demand are summarized in tabular form, as follows:[3]

	Population		Gross National Product in 1953 Dollars		
Projections	1975	2000	1975	2000	Price
	(Millions)		(Billion Dols.)		
Medium	215	275	630	1,200	No change in relative prices; trends in price of timber will parallel price trends of competing materials.
Upper	228	360	645	1.450	
Lower	215	275	630	1,200	Prices of timber will rise substantially faster than prices of competing materials, and extensive substitution will occur

The authors wish to emphasize that none of the projections is a forecast of what will occur. They represent alternative choices based on reasonable assumptions.

In light of the basic assumptions and economic projections, the demand for, or future consumption of, timber is expected to increase under each of the three projections. By the year 2000, the lower, medium, and upper projections of demand for timber products as a group, will be 46, 83, and 114 per cent greater than the 1952 consumption.

Estimated Future Supply

Estimates of projected timber supplies for future periods were also presented in the "Timber Resource Review." The assumptions made for supply projections were:

---

[3] *Ibid.*, p. 16.

1. Timber removal will climb steadily and timber demands will be met each year.
2. Forestry will continue to intensify and accelerate as indicated by recent trends.

Based upon these assumptions, the growth and inventory projections estimated the supplies that could be expected in 1975 and 2000. If medium timber demands are met each year, projected sawtimber growth in relation to needed growth will show a deficit of 14 percent by 1975 and 76 percent by 2000. If lower instead of medium demands are met, there will be a slight surplus of sawtimber growth by 1975 but a 16 per cent deficit by 2000. There is no timber famine in the offing, but some shortages can be expected, especially of softwood sawtimber of preferred species and grades, and especially after 1975. There is no danger that timber will become a surplus crop.

Estimated Future Prices

The preceding discussion related primarily to the timber demand and supply outlook. In this report the price outlook is of primary concern, particularly for pulpwood and sawtimber.

A study of the long-term trends in the price of pulpwood is difficult because of the lack of satisfactory price data. A reliable indicator, however, is a composite price index that includes not only the price of market pulp but also the price of paper and paperboard. A separate price-consumption analysis for woodpulp, paper, and paperboard would be desirable, but there is no officially compiled series on the long-term price of pulpwood.

The composite price index of woodpulp products has fluctuated moderately from 1920 to 1954 but the tendency has been for the price of woodpulp products to stay in line with the general trend of all commodity prices. In other words, the real price of woodpulp has been remarkably stable during the past 35 years. In light of past price behavior it is reasonable to assume no change in the real price of pulpwood in the projections for 1975 and 2000. Thus the *current price relationship for pulpwood is expected to prevail* when pulpwood becomes available from current plantings.

In the same way that *real price*[4] is used to indicate the future price position of pulpwood, it is also possible to estimate future lumber prices. For lumber, however, the real price in the past 35 years was not as stable as it was for pulpwood. From 1920 to 1954, the real price of lumber increased about 80 per cent. Extending the comparison back to 1900, the real price increase amounted to almost 190 per cent. Therefore, in making projections of future demand, the "Timber Resource Review" assumed a substantial price rise for the years 1975 and 2000.

---

[4] Real price is an index designed to measure price change while taking into account the change in the buying power of the dollar. It is derived by dividing the index of the average price of lumber by the all-commodity price index for a given year and multiplying by 100. In this analysis, 1926 was used as the base year.

The lower projection of lumber demand indicated that if the past relationship between real price and relative consumption continues to hold through the year 2000, the real price of lumber will increase by 38 per cent to 1975, and by 97 per cent to the year 2000. Thus, the price outlook for sawtimber will continue to improve with the passage of time.

The price for poles hinges largely upon the price for sawtimber. Generally, poles command a premium over equivalent sawlog prices and fulfill the needs of a specialized and very limited market. Poles are priced by classification based upon diameter, length, and degree of imperfections and taper. It is, therefore, very difficult to generalize about pole prices except to say that if one is fortunate enough to have a market outlet for poles, the pole price per board foot will usually be somewhat higher than the price per board foot in sawlogs.

PLANTING AND MANAGEMENT COSTS

An old field recently taken out of cultivation and still free from undesirable hardwoods makes an excellent tree planting site. The cost of setting out seedlings on this type of site will be at a minimum. The estimated cost of planting one acre of pine in an open field and without financial aid from the government agencies is given in Table 2. These figures may be reduced by cost-sharing through government programs. One cannot, however, depend upon this aid indefinitely. Nevertheless, the

TABLE 2.—Cost of Planting and Managing an Acre of Loblolly Pine in North Louisiana

Planting Cost				
1,000 Pine Seedlings		$4.25		
Shipping Costs		.50		
Labor and Equipment	(By machine)	8.82	(By Hand)	10.52
Total	”	$13.57	”	$15.27
Annual Maintenance Cost				
Property Tax		$0.25		
Fire Protection		.02		
Management Cost		$1.00		
Total Annual Cost		$1.27		

current availability of government aid should not be overlooked if immediate planting is being considered.[5]

The possibility of lowering establishment costs by direct seeding is still being investigated. Seed treatment for protection against rodents and birds is rather well perfected, but results on site preparation and survival related to direct seeding are still inconclusive. It may be that in the near future direct seeding will be a common practice and cost of planting will be somewhat lower. Preliminary direct seeding tests have indicated a planting cost of approximately $5 per acre.

Seedlings can be obtained from state nurseries at a price of $4.25 per thousand plus about $.50 for shipping. Labor and machine costs are the big variables. The $8.82 and $10.52 costs shown for machine and hand planting, respectively, are average figures and are not meant to suggest minimum costs.

It is generally accepted that about 1,000 seedlings are needed to plant one acre of pine. Actually, a 6' x 8' spacing accommodates 908 trees per acre. This number is somewhat lower than the number of stems that have been observed on fully stocked natural stands. It has been observed

State nurseries furnish pine seedlings at $4.25 per thousand, but with proper certification from the county agent, the first 5,000 may be obtained at 50 cents a thousand.

---

[5] Landowners, with proper certification from the County Agent, can obtain the first 5,000 seedlings from the Louisiana Forestry Commission at a nominal cost of $.50 per thousand and also receive a cost-share of $6.00 per acre from the ASC to aid in establishing plantations. There is also a further possibility of obtaining annual rental payments under the Soil Bank Program.

that about 70 to 75 percent of the planted seedlings survive until the time of the first thinning at 15 years.

Taxes, fire protection, and management costs are expenses that occur annually. Taxes assessed against forest land in North Louisiana vary from parish to parish. The average was $.25 per acre for a six-parish area recently studied; the uniform cost for fire protection is $.02 per acre. Labor required to manage a farm forest has been estimated at $1.00 per acre per year, based upon reports from the Forest Experiment Station at Crossett, Arkansas. These reports estimate that it would take about one hour per year for a farmer to manage one acre of forest land. This would cover the cost of supervising, marking, and scaling.

VALUE OF PLANTED PINE STAND AT VARIOUS AGES

The first marketable yield of pulpwood from a planted stand will be available at approximately 15 years of age. The average tree measurement will then be about 5.4 inches in diameter, breast high, and 29 feet in height (Table 1, Page 5). An acre of planted loblolly pine at 15 years will contain about 17.2 cords of pulpwood. Of this amount, 5.1 cords will normally be harvested in the first thinning operation. It is expected that the price per cord will be somewhat lower for the first cutting because of the small diameter size. In this instance it is assumed the price at 15 years of age will be about $4 per cord and subsequent harvests will sell at the average price of $4.25 per cord.

The per acre value of planted timber, at various ages, will vary according to its intended use. Research and experience have demonstrated that the primary use for loblolly pine, up to 35 years of age, is pulpwood. At 40 years and beyond, the trees will have attained an average diameter of about 11.8 inches and are then suitable for a higher priced use, such as sawtimber or utility poles.

The utility pole market is very selective and not always available. Furthermore, it is estimated that a planted and well-managed acre of loblolly pines, at 40 years of age, will yield only about 15 pole trees. Other trees will have too many defects to qualify for the pole market. Defects include cracks, holes, splits, checks, insect damage, knots, crooks, and excessive sweep. Thus, it is assumed in this analysis that a possible pole yield will be limited to one cutting, consisting of 15 trees at 40 years of age. The current stumpage value of 15 pole trees (40-foot pole in class 4 @ $4.50) would amount to about $67.50, or $42.36 higher than the value of the trees if sold as sawtimber. Therefore, the value of the stand at 40 years of age could reasonably be $251.40 if value is assessed only as sawtimber, or $293.66 if additional value from 15 utility poles is taken

Plantation thinnings provide additional income through marketing of pulpwood.

into account. At 60 years the acreage value of standing timber will probably be at its peak, an estimated $455.

Returns from pulpwood thinnings will be greatest at 25 years of age, when 8.5 cords can be thinned from each acre of planted pine. Returns from sawlogs will probably be greatest at 60 years (Table 1, Page 5).

If 35 years is regarded as the age of pulpwood maturity, then the accumulated value realized from periodic thinnings will amount to about $150 or, if allocated on an annual basis, $4.28 per acre per year.

At 40 years and beyond, timber will be thinned at 10-year intervals up to 60 years of age. Returns from these thinnings are based on the sale of sawlogs instead of pulpwood, and when allocated on an annual basis at projected prices will amount to almost $25 per acre per year.

Two possible management practices have been suggested for 60-year-old timber. Either the entire stand can be cut and the land replanted with pine seedlings, or a so-called "shelterwood cut" can remove slightly more than half of the stand, leaving about 30 trees per acre to produce seed and provide shelter for new seedling growth. At 65 years, all but six seed trees can be removed. Finally, at 70 years, the six seed trees can be cut. It is assumed that a natural stand of seedlings will have developed, thus eliminating the need for replanting the forest site. The latter practice has been assumed for this analysis.

ESTIMATED RETURNS FOR PULPWOOD AND SAWTIMBER

If, in addition to realizing returns from periodic thinning operations, the forest owner reinvests thinning returns at four percent, compounded annually, then the cumulative value of interest earned and pulpwood growth will be about $344 at 35 years (Table 3).

TABLE 3.—Estimated Returns Per Acre of Pulpwood and Sawtimber When Returns from Thinnings Are Compounded Annually at Four Percent (1958 Prices and Projected Prices for Year 2000)

Age of Stand	Thinning Returns			Value of Remaining Stand	Total Value Cumulative & Compounded
	Actual	Compounded	Compounded & Cumulative		
15	$20.40	——	$20.40	$48.40	$68.80
20	25.08	24.83	49.91	77.35	127.26
25	36.12	60.74	96.86	100.30	197.16
30	35.28	117.88	153.16	111.78	264.94
35	33.15	186.40	219.55	124.10	343.65
Sawtimber at current prices ($30 per thousand board feet)					
40	50.28	267.18	317.46	201.12	518.58
50	187.23	469.87	657.07	262.11	919.18
60	260.16	972.46	1,232.62	195.12	1,427.74
65	192.42	1,500.10	1,692.52	48.09	1,740.61
70	60.30	2,059.80	2,120.10	——	2,120.10
Sawtimber values projected to year 2000 at estimated price of $59 per thousand board feet[1]					
40	98.88	267.18	366.06	395.54	761.60
50	368.22	541.76	909.98	515.48	1,425.46
60	511.65	1,346.78	1,858.43	383.74	2,242.17
65	378.43	2,261.72	2,640.15	94.58	2,734.73
70	118.59	3,213.06	3,331.65	——	3,331.65

[1] Projected real price reflects purchasing power 97 percent above 1957-58 price structure.

It is recognized, however, that at 40 years of age the trees should be of sufficient size to qualify for higher priced uses, that is, as poles or sawtimber. If a market for poles is available, this would be the recommended use. Trees which qualify as poles ordinarily claim a higher price than an equal volume of sawtimber.

As indicated previously, approximately 15 trees per acre will qualify as poles and all of these will probably be harvested at 40 years of age. The current stumpage value per pole at 40 years is estimated to be about $4.50. The value of the same tree when marketed for sawtimber is about $1.70.

Assuming that the future price projections discussed earlier are reasonably accurate, the real prices of sawtimber and poles by the year 2000 will be almost double the current prices.

Since an available market for poles is not assured while a ready market for sawlogs is reasonably certain, the timber values beyond 40 years of age will be confined to an evaluation based upon sawtimber use.

At current prices the value of an acre of planted pine at 40 years of age (150 trees) is calculated to be about $251.40. The accumulated returns, if income from harvested thinnings is reinvested at 4 percent compounded annually, will amount to $518.58, or better than double the value of the 40-year stand. Total value (accumulated returns) at current prices will amount to $2,120.10 per acre in 70 years. If the real price increases by 97 percent as predicted by future projections, the accumulated value at 70 years will be $3,331.65 (Table 3).

Straight and slender pines are peeled and dried for a select utility pole market.

ESTIMATED NET ANNUAL RETURNS

In the foregoing discussion only total returns were mentioned. It is much more important to regard an enterprise in light of net returns. To the farmer or landowner, net annual returns per acre are probably th most meaningful measures of the profitability of a tree enterprise. Subsequent discussion will deal with estimated net annual returns realize per acre of planted loblolly pine.

Before proceeding with this discussion, however, it is well to poin out that an estimate of total returns is quite simple once the volume o production and the stumpage price are established. But when it comes t assessing costs, the problem becomes quite complex. First, should ther be a rental charge assessed for the use of land? Here we have assume that the land is already owned by the one considering tree farming an the only charge for land is the annual property tax and the fire protec

TABLE 4.–Estimated Net Annual Returns Per Acre of Even-Aged Loblolly Pine Whe Compounding Costs and Thinning Returns, As Indicated, at Four Percen Using Current and Projected Prices

Situation A – Farmer putting tillable land in trees with planting costs shared by AC and seedlings at 50 cents per thousand[1]

Assuming:
1. No rental for land except taxes, 27 cents per acre
2. No site preparation required
3. Planting costs and seedlings, $3.82, compounded
4. No management costs
5. Thinning returns not reinvested

Age of Stand	Accumulated Returns	Costs Compounded	Net Return	
			Total	Per Year
		Pulpwood		
15	$ 68.80	$ 6.88	$ 61.92	$ 4.13
20	122.83	8.37	114.46	5.72
25	181.90	10.18	171.72	6.87
30	228.65	12.39	216.26	7.21
35	274.13	15.07	259.06	7.40
		Sawtimber—at current prices		
40	401.43	18.34	383.09	9.58
50	649.65	27.15	622.50	12.45
60	842.82	40.19	802.63	13.38
65	888.21	48.87	839.34	12.91
70	900.42	59.49	840.93	12.01
		Sawtimber—at projected prices—year 2000[2]		
40	644.45	18.34	626.11	15.65
50	1,132.61	27.15	1,105.46	22.11
60	1,512.52	40.19	1,472.33	24.54
65	1,601.79	48.87	1,552.92	23.89
70	1,625.80	59.49	1,566.31	22.38

(Continued

---

[1] First 5,000 trees requested by a landowner may be obtained from Louisiana Forestry Commission at 50 cents per thousand.

[2] Projected real price reflects purchasing power 97 percent above 1957-58 price structure.

tion cost. Furthermore, land values in North Louisiana are appreciating at a rate of about 4 percent per year, and this tends to repay the landowner for capital invested in land. It could also be argued that the property tax should not be included as part of the tree production cost because the landowner will pay the property tax whether or not he has trees planted. Second, what is a valid planting cost? If planting is done by machine, and the machine can be borrowed from a public or private source, the cost will be about $1.57 less than if done by hand. Furthermore, the Agricultural Conservation Program and the Soil Bank Program both offer financial aid in meeting the costs of tree planting and are now (1959) paying as such as $6 per acre. In addition, the Soil Bank Program makes available, on a 10-year contract basis to qualified landowners, an annual rental payment of $3 to $25 per acre.

TABLE 4. (CONTINUED)

Situation B—Farmer putting cropland in trees aided by the Soil Bank Program

Assuming:
1. No rental for land except taxes
2. No site preparation required
3. Planting cost, $3.32; seedlings, $4.25; total, $7.57
4. No management costs
5. Thinning returns not reinvested

Age of Stand	Accumulated Returns	Costs Compounded	Net Return	
			Total	Per Year
		Pulpwood		
1-10[1]				
15	$ 68.80	$ 13.63	$ 55.17	$ 3.68
20	122.83	16.58	106.25	5.31
25	181.90	20.18	161.72	6.47
30	228.65	24.55	204.10	6.80
35	274.13	29.87	244.26	6.98
		Sawtimber—at current prices		
40	401.43	36.34	365.09	9.13
50	649.65	53.80	595.85	11.92
60	842.82	79.64	763.18	12.72
65	888.21	96.84	791.37	12.17
70	900.42	117.88	782.54	11.18
		Sawtimber—at projected prices—year 2000[2]		
40	644.45	36.34	608.11	15.20
50	1,132.61	53.80	1,078.81	21.58
60	1,512.52	79.64	1,432.88	23.88
65	1,601.79	96.84	1,504.95	23.15
70	1,625.80	117.88	1,507.92	21.54

(Continued)

[1] $3 to $25 annual rental possible from Soil Bank Program.

[2] Projected real price reflects purchasing power 97 percent above 1957-58 price structure.

Another consideration is that up to 5,000 seedlings may be obtaine from the Louisiana Forestry Commission at a rate of 50 cents per thousand. To be eligible the landowner must obtain prior certification from his County Agent. Quantities in excess of 5,000 are obtained at a cos of $4.25 per thousand.

Forest management includes the supervising, marking, and scaling o the woodlot. Although it has been estimated that only one hour per acr per year is required for management, there is some question as to whethe this should be charged to the tree enterprise. A farmer or small landowner may very readily find a spare hour or two during the year to perform what little management is necessary. Furthermore, it is possible, in man cases, to obtain assistance from Extension foresters in much the same wa that farmers obtain help from the County Agent.

TABLE 4. (CONTINUED)

Situation C—Landowner considering planting trees, without benefit of subsidies, with all costs and returns compounded at four percent

Assuming:
1. No rental for land except taxes
2. No site preparation required
3. Planting cost and seedlings, $13.57
4. Management and taxes, $1.27 per year
5. Thinning returns reinvested at four percent

Age of Stand	Accumulated Thinning Returns Cmpd.	Costs Compounded (1.27 + 13.57)	Net Return	
			Total	Per Year
		Pulpwood		
15	$ 68.80	$ 49.87	$ 18.93	$ 1.26
20	127.26	67.55	59.71	2.98
25	197.16	89.07	108.09	4.32
30	264.94	115.24	149.70	4.99
35	343.64	147.09	196.55	5.62
		Sawtimber—at current prices		
40	518.58	185.83	332.75	8.32
50	919.18	290.33	628.85	12.58
60	1,427.74	445.01	982.73	16.38
65	1,740.61	548.03	1,192.58	18.35
70	2,120.10	673.96	1,446.14	20.66
		Sawtimber—at projected prices—year 2000[1]		
40	761.60	185.83	575.77	14.39
50	1,425.47	290.33	1,135.14	22.70
60	2,242.18	445.01	1,797.17	29.95
65	2,734.73	548.03	2,186.70	33.64
70	3,331.65	673.96	2,657.69	37.97

(Continued)

[1] Projected real price reflects purchasing power 97 percent above 1957-58 price structure.

Another question associated with the computation of net income is whether or not all elements of cost and returns should be compounded and treated as reinvestment income. The subsistence farmers are more concerned with realizing frequent returns while others may be primarily interested in investing for long-term capital growth.

Although many possible variations could be used in computing net returns to an acre of planted pine, six of the most common situations are presented in Table 4. Other special situations can be worked out by the reader through use of the basic information contained in the Appendix tables of this report.

In Situations A and B the landowners are receiving subsidies to help finance the cost of planting. Trees are being planted on idle cropland, thus requiring no site preparation. Management costs are ignored, and periodic returns from thinning operations are used as subsistence income.

In Situation C the landowner does not have government subsidies to help meet planting costs. All costs are compounded annually at four percent, and periodic returns from thinnings are reinvested at four percent compounded annually.

Situation D provides three variations of Situation C. Costs and returns are treated the same as in Situation C except that site preparation costs of $10, $30, and $50 are added to the planting costs.

TABLE 4. (CONTINUED)

Situation D_1—Same as Situation C except $10 site preparation added to planting cost

Age of Stand	Accumulated Returns, Thinning Returns Compounded	Costs Compounded	Total Return	
			Total	Per Year
		Pulpwood		
15	$ 68.80	$ 67.88	$ .92	$ .06
20	127.26	89.46	37.80	1.89
25	197.16	115.73	81.43	3.26
30	264.94	147.67	117.27	3.91
35	343.64	186.55	157.09	4.49
		Sawtimber—at current prices		
40	518.58	233.84	284.78	7.12
50	919.18	361.40	557.78	11.15
60	1,427.74	550.21	877.53	14.62
65	1,740.61	675.96	1,064.65	16.38
70	2,120.10	829.68	1,290.42	18.43
		Sawtimber—at projected prices—year 2000[1]		
40	761.47	233.84	527.76	13.19
50	1,425.47	361.40	1,064.07	21.28
60	2,242.18	550.21	1,691.97	28.20
65	2,734.73	675.96	2,058.77	31.67
70	3,331.65	829.68	2,501.97	35.74

(Continued)

[1] Projected real price reflects purchasing power 97 percent above 1957-58 price structure.

TABLE 4. (CONTINUED)

Situation D_3—Same as Situation C except $30 site preparation added to planting cost

Age of Stand	Accumulated Returns, Thinning Returns Compounded	Costs Compounded	Total Return	
			Total	Per Year
		Pulpwood		
15	$ 68.80	$ 103.90	$ - 35.10	$- 2.34
20	127.26	133.28	- 6.02	- 0.30
25	197.16	169.05	28.11	1.12
30	264.94	212.53	52.41	1.74
35	343.64	265.47	78.17	2.23
	Sawtimber—at current prices			
40	518.58	329.86	188.72	4.72
50	919.18	503.54	415.64	6.31
60	1,427.74	760.61	667.13	11.12
65	1,740.61	931.82	808.89	12.44
70	2,120.10	1,141.12	978.98	13.98
	Sawtimber—at projected prices—year 2000[1]			
40	761.60	329.86	431.74	10.79
50	1,425.47	503.54	921.93	18.44
60	2,242.18	760.61	1,481.57	24.69
65	2,734.73	931.82	1,802.91	27.73
70	3,331.65	1,141.12	2,190.53	31.29

(Continued)

[1] Projected real price reflects purchasing power 97 percent above 1957-58 price structure.

TABLE 4. (CONTINUED)

Situation D_5—Same as Situation C except $50 site preparation added to planting cost

Age of Stand	Accumulated Returns, Thinning Returns Compounded	Costs Compounded	Net Return	
			Total	Per Year
		Pulpwood		
15	$ 68.80	$ 139.92	$ - 71.12	$- 4.74
20	127.26	177.10	- 49.84	- 2.49
25	197.16	222.37	- 25.21	- 1.01
30	264.94	277.39	- 12.45	- 0.42
35	343.64	344.39	- 0.75	- 0.02
	Sawtimber—at current prices			
40	518.58	425.88	92.70	2.32
50	919.18	645.68	273.50	5.47
60	1,427.74	971.01	456.73	7.61
65	1,740.61	1,187.68	552.93	8.51
70	2,120.10	1,452.56	667.54	9.53
	Sawtimber—at projected prices—year 2000[1]			
40	761.60	425.88	335.72	8.39
50	1,425.47	645.68	779.79	15.59
60	2,242.18	971.01	1,271.17	21.18
65	2,734.73	1,187.68	1,547.05	23.80
70	3,331.65	1,452.56	1,879.09	26.84

[1] Projected real price reflects purchasing power 97 percent above 1957-58 price structure.

In some areas, site preparation requires costly land-clearing operations.

THE MOST PROFITABLE ROTATION

Ordinarily the optimum situation for a production process is the point where marginal cost is equal to marginal revenue, that is, the point where net revenue is at a maximum. If the element of time is introduced and a charge is imposed for the use of capital over time, then the optimum would occur at a point where discounted net revenue is greatest. It was the latter analysis which provided figures representing the annual net returns illustrated in the foregoing charts and tables.

A question frequently asked, however, is, "What is the most desirable rotation for a pulpwood planting?" The answer to this depends upon the landholder's objective. If his objective is to have a turnover of capital at the earliest possible date without sacrificing earning potential, he will want to cut pulpwood when the internal rate of return is at a maximum, that is, when the compound interest earned on the investment is highest. If, on the other hand, his objective is to have his capital invested as long as its earnings are increasing above the normal rate of interest (assumed here to be four percent), then he will be interested in cutting when discounted net revenue is at a maximum.

Assuming that the landholder's objective is to have early returns without sacrificing earning potential, he will then clear cut pulpwood at about 25 years of age, for at this age the internal rate of return is highest.

If only planting costs are considered and costs of management and taxes are ignored, the internal rate of return at 25 years is about 12.4 per cent. When management and taxes are included as part of the cost, the internal rate of return at 20 and 25 years is about 8 percent (Table 5).

When calculating the internal rate of return, as indicated in Table 5, thinning returns were considered a part of the returns at final harvest and were not credited with additional value because of their earlier availability to the investor.

Assuming that a landowner wishes to maximize his internal rate of return from a sawlog rotation and the real price for sawtimber 40 years

TABLE 5.—Internal Rate of Return Resulting from Timber Harvest at Various Ages

Age of Stand	Total Returns*	Internal Rate of Return When Considering:	
		Only Planting Costs ($13.57)	Planting Costs Plus Management and Taxes** ($13.57 + $1.27)
		(Percent)	
	Pulpwood		
15	$ 68.80	11.4	6.9
20	122.83	11.6	**8.1**
25	181.90	**12.4**	**8.0**
30	228.65	9.8	7.1
35	274.13	9.0	6.4
	Sawtimber—at current prices		
40	401.43	8.8	6.6
50	649.65	8.1	6.1
60	842.82	7.1	5.3
65	888.21	6.6	5.0
70	900.42	6.1	4.6
	Sawtimber—at projected prices—year 2000		
40	644.45	10.1	**8.1**
50	1,132.61	9.3	**7.5**
60	1,512.52	8.2	6.5
65	1,601.79	7.6	6.0
70	1,625.80	7.1	5.5

*Thinning returns accumulated but not compounded.

**Approximate because of interpolation from tables in conjunction with formula:

$$C_1 (1 + i)^n + C_2 \frac{(1 + i)^n - 1}{i} = R$$

C_1 = Initial planting costs
C_2 = Annual management and taxes
i = Internal rate of return
n = Age of stand
R = Total return

hence will be 97 percent higher than at present, the highest rate of return occurs at 40 years, and a 40-year sawlog rotation is suggested (Table 5).

Under conditions where the objective is to maximize discounted net revenue, a 60-year rotation is suggested. This is illustrated in Table 6.

TABLE 6.—Costs, Returns, and Discounted Net Revenue Associated with an Acre of Planted Loblolly Pine When Cut at Various Ages and Sold as Pulpwood and Sawtimber. (Pulpwood at $4-$4.25 Per Cord, Sawtimber at $30 and $59 Per Thousand Board Feet—Doyle Rule)

Age of Stand	Total Revenue[1]	Total Cost[2]	Net Revenue	Four Percent Discount Factor	Discounted Net Revenue[3]
			Dollars		
			Pulpwood		
15	68.80	49.87	18.93	1.801	10.51
20	127.26	67.55	59.71	2.191	27.25
25	197.16	89.07	108.09	2,666	40.54
30	264.94	115.24	149.70	3.243	46.16
35	343.64	147.09	196.55	3.946	49.81
			Sawtimber at current prices		
40	518.58	185.83	332.75	4.801	69.31
50	919.18	290.33	628.85	7.107	88.48
60	1,427.74	443.01	984.73	10.520	**93.60**
65	1,740.61	548.03	1,192.58	12.793	93.22
70	2,120.10	673.96	1,446.14	15.572	92.87
			Sawtimber—at projected prices—year 2000		
40	761.60	185.83	575.77	4.801	119.93
50	1,425.47	290.33	1,135.14	7.107	159.72
60	2,242.18	443.01	1,799.17	10.520	**171.02**
65	2,734.73	548.03	2,186.70	12.793	170.93
70	3,331.65	673.96	2,657.69	15.572	170.67

[1] Thinning returns compounded annually at four percent.

[2] Capital invested at four percent compounded annually.

[3] The amount of money that would have to be invested at four percent compounded annually to earn the net revenue shown for the stated number of years.

SUMMARY AND CONCLUSIONS

Will it be profitable to plant pine trees today with the hope of harvesting pulpwood 15 to 35 years later, and possibly harvesting poles and sawlogs beyond 35 years? This is the question basically considered in this report.

The data and analyses apply particularly to loblolly pine and growing conditions found in North Louisiana.

In light of the price relationships existing in the past and the price outlook for the future, it has been conservatively estimated that for the next 40 years the stumpage price of pulpwood will maintain the same relative position with respect to the composite wholesale price of all commodities. The price for sawlogs and poles, however, is expected to show a substantial relative increase.

In terms of current (1958) dollars, the net profit to be expected from pulpwood harvest at 25 to 30 years will probably amount to $4 or $5 per acre per year. The annual net return to sawlogs at 40 years, on the basis of current dollars, will be slightly more than $8 per acre, and by the 70th year will be more than $20 per acre. But with the optimistic outlook prediction of a substantial increase in the price of sawtimber, it might be more appropriate, in terms of current purchasing power, to expect the annual returns from sawtimber to amount to more than $14 per acre in 40 years and $35 per acre in 70 years.

The limited market for poles necessarily restricts any generalization as to potential returns from this select product. It is possible to estimate, however, that about 15 trees per acre will qualify as poles and the price for these medium size poles will be somewhat higher than the price for an equal volume of sawtimber.

The returns, as stated, assume that the landowner has idle fields on which to plant trees and that he will receive no government subsidies. If government aid is available, in the form of cost-sharing or rental payments, the returns will be substantially greater, as indicated in Situations A and B in the text of this report.

Assuming that the landowner wishes to have a more rapid turnover for reinvestment purposes, without loss of capital earnings, the desirable rotation for pulpwood appears to be about 25 years. If discounted net revenue is to be maximized, a 60-year sawtimber rotation is suggested.

The compound interest rate resulting from timber growth is at a maximum at 25 years of age. It amounts to 12.4 percent when the only cost involved is a planting cost of $13.57 per acre. This rate of return is even higher than that possibly realized from sawtimber production at the 97 percent higher price predicted for the year 2000.

If a charge of $1.27 for management, taxes, and fire protection is added to the planting cost of $13.57, a compound interest rate of approximately 8 percent is realized either from a pulpwood harvest at 20 to 25 years or from a sawtimber harvest at 40 years, assuming a 97 percent higher price for sawtimber 40 years hence.

The forest management practice illustrated by the growth and harvest data used in this report is designed to have the forest regenerate itself, thus eliminating the need for replanting after the initial stand is harvested. This implies that future generations of forest owners may avoid the initial cost of tree planting and have only the nominal cost of management, taxes, and fire protection to be considered. The rate of return under such conditions would be considerably higher than those presented in this analysis.

How much can a landowner afford to spend for site preparation? On the basis of pulpwood production it does not appear advisable to exceed $50 per acre. A sum of $50 for site preparation added to the cost of planting, management and taxes, will just about cancel out any profits realized beyond the normal four percent return expected from a conservative long-term investment.

It could therefore be reasoned that, if a person were satisfied with a normal four percent return on a 40-year investment, he could afford to pay $50 per acre for land which requires no site preparation prior to tree planting.

It is possible that returns realized from the harvest of sawtimber might be slightly greater if, after the sawlogs are measured and cut, the tops and branches are salvaged for pulpwood use. This additional source of revenue, however, would be relatively small and very difficult to estimate. Hence, it was not included in calculating the estimtaed returns from the sale of sawtimber.

APPENDIX

Procedure

In gathering the information for this bulletin, the authors studied many articles and forestry reports to obtain a basic knowledge of the problems involved. This was followed by a survey of the area to gain first-hand information from farmers, foresters, government agencies, and interested land holding companies.

Growth and cost figures were then assembled and analyzed to establish data that could be used for estimating the profitability of planting pine trees.

Outlook information was based entirely upon the "Timber Resource Review" contained in *Forest Resource Report No. 14,* U. S. Forest Service, January 1958.

Sources of Data

Cost Figures:

a. Cost of seedlings was reported by the Louisiana Forestry Commission.
b. Shipping charges were based upon average cost for transporting seedlings approximately 100 miles.
c. Labor and equipment costs were determined by consulting with foresters, soil conservation representatives, and tree planting industries, and by comparing these reports with numerous publications on the subject.
d. Annual management costs were assumed to be similar to those reported for managing the Crossett Farm Forties in Arkansas.
e. The 25 cents annual tax per acre is the average computed for six parishes in North Louisiana, where the range in taxes varied from 17¾ to 58¾ cents depending upon the type of school and road district. A standard fire protection assessment of 2 cents per acre is also included.

Prices:

a. Stumpage prices for *pulp* and *sawlogs* are the prices most frequently reported for North Louisiana, based upon the Louisiana Timber Products Quarterly Market Report, July 31, 1958.
b. Stumpage prices for poles of various classes were computed from *Pole Growers Guide* by Hamlin L. Williston, Southern Forest Experiment Station. Occasional Paper 153, 1957.

Growth of Loblolly Pine:

a. Growth and volume data were obtained through consultation with B. A. Bateman, A. B. Crow and R. W. McDermid, School of Forestry, Louisiana State University.

b. A site index of 80 (height of tree at 50 years of age) was considered appropriate for loblolly pines in North Louisiana.

APPENDIX TABLE 1.—Indicated Costs Compounded at Four Percent Per Year

Year	Annual Costs		Initial Planting Costs					
	$0.27[1]	$1.27[2]	$3.82[3]	$7.57[3]	$10.00[5]	$13.57[4]	$30.00[5]	$50.00[5]
15	5.41	25.43	6.88	13.63	18.01	24.44	54.03	90.05
20	8.04	37.82	8.37	16.58	21.91	29.73	65.73	109.55
25	11.24	52.89	10.18	20.18	26.66	36.18	79.98	133.30
30	15.14	71.23	12.39	24.55	32.43	44.01	97.29	162.15
35	19.89	93.54	15.07	29.87	39.46	53.55	118.38	197.30
40	25.66	120.68	18.34	36.34	48.01	65.15	144.03	240.05
45	32.68	153.71	22.31	44.22	58.41	79.26	175.23	292.05
50	41.22	193.89	27.15	53.80	71.07	96.44	213.21	355.35
60	64.36	302.25	40.19	79.64	105.20	142.76	315.60	526.00
65	79.60	374.43	48.87	96.84	127.93	173.60	383.79	639.65
70	98.36	462.65	59.49	117.88	155.72	211.31	467.16	778.60

[1] Property tax plus fire protection assessment.

[2] Cost of management plus taxes.

[3] Partially subsidized planting costs.

[4] Planting costs without direct subsidy.

[5] Various levels of site preparation.

APPENDIX TABLE 2.—Factors Used to Determine Periodic Values and Annuities When Compounding Annually at Four Percent

Year	Compounding One Initial Investment	Compounding Fixed Annual Increments
5	1.217	5.4163
10	1.480	12.0061
15	1.801	20.0236
20	2.191	29.7781
25	2.666	41.6459
30	3.243	56.0849
35	3.946	73.6522
40	4.801*	95.0255**
45	5.841	121.0293
50	7.107	152.6671
60	10.520	237.9907
65	12.793	294.8250
70	15.572	364.2904

Source: Bogen, J. I., *Financial Handbook,* Third Edition, 1956, The Ronald Press Company, New York, pp. 1179 and 1192.

To illustrate the use of the above factors:

*Planting cost of $13.57 compounded annually at 4 percent will amount to $65.15 in 40 years ($13.57 x 4.801 = $65.15).

**Taxes of 27 cents per year for 40 years, compounded annually at 4 percent, will amount to $25.66 ($0.27 x 95.0255 = $25.66).

APPENDIX TABLE 3.—Estimated Total Values Per Acre of Loblolly Pine, if Cl Cut at Various Ages, When Thinning Returns Are Sim Accumulated and When Compounded and Accumulated

Age of Stand	Ordinary Values	Compounded Values[1]
	Pulpwood	
15	68.80	68.80
20	122.83	127.26
25	181.90	197.16
30	228.65	264.94
35	274.13	
	Sawtimber — at current prices	
40	401.43	518.58
50	649.65	919.18
60	842.82	1,427.74
65	888.21	1,740.61
70	900.42	2,120.10
	Sawtimber — at projected prices — year 2000[2]	
40	644.45	761.60
50	1,132.61	1,425.46
60	1,512.52	2,242.17
65	1,601.79	2,734.73
70	1,625.80	3,331.65

---

[1] Compounded annually at four percent.

[2] Projected real price reflects purchasing power 97 percent above 1957-58 price structure.

30,73
936
nd set

The Rural-Urban Fringe and Louisiana's Agriculture

A Case Study of the Baton Rouge Area

UNIVERSITY OF MARYLAND
LIBRARY
SEP 24 1962

TECHNOLOGY AND SCIENCE ROOM

by

Paul H. Price and George A. Hillery, Jr.

letin No. 526 June 1959

ricultural Experiment Station
Charles W. Upp, Director

Louisiana State University and
Agricultural and Mechanical College

TABLE OF CONTENTS

I. INTRODUCTION 3
  1. Nature of the Problem 3
  2. Hypotheses 4
  3. Characteristics of the Sample 9
  4. The Nature and Use of Samples 11
    Probability 12
    Chi Square: The Measure of Probability 12
  5. Plan of the Study 14

II. THE MERGING PATTERN 15
  1. Institutional Patterns 15
    The Family 15
    Education 18
    Economics 18
  2. Activities and Interaction 19
  3. Attitudes and Values 25

III. EXPECTED DIFFERENCES 31
  1. Occupation and Employment 31
  2. Ecological Mobility 33

IV. THE IMPACT ON FRINGE AGRICULTURE 36
  1. The Farmers 37
  2. Nonfarmers 38

V. SUMMARY AND CONCLUSIONS 40
  1. Assessment of the Rural-Urban Differences 40
  2. Implications 45

TECHNICAL APPENDIX 47
  1. Theory and Concepts 47
    Formation of Hypotheses 47
    Method 49
    The Terms "Fringe" and "Suburban" 49
  2. Statistical Considerations 49
    The Use of the .10 Level of Significance 49
    The Use of Chi Square 51
    Percentages 51
    Qualifications of the Sample 51

The Rural-Urban Fringe and Louisiana's Agriculture

A Case Study of the Baton Rouge Area

PAUL H. PRICE AND GEORGE A. HILLERY, JR.[1]
DEPARTMENT OF RURAL SOCIOLOGY

I. INTRODUCTION

1. Nature of the Problem

In Louisiana, as in other sectors of the nation undergoing urbanization and industrialization, the twentieth century has witnessed a vast expansion of urban populations beyond the areas which have long been their legal as well as their traditional boundaries. This expansion has resulted from, and at the same time further stimulated, the development of rapid and cheap means of transportation, the construction of an adequate system of paved highways, and the continued industrialization of the state. For the most part, the fringe movement in Louisiana seems to have commenced in the late twenties and early thirties and to have reached particularly significant proportions in the present decade.

In 1959, Louisiana has three metropolitan centers which have been encircled by rural-urban fringes of considerable magnitudes. These are New Orleans, Baton Rouge, and Shreveport. Many of the smaller cities have also developed rural-urban fringes. Furthermore, there is little indication that this suburbanization is slowing or terminating. The effects of the trend have become, if anything, more extensive and more diversified. The areas included in the rural-urban fringe contain farm people who resided in the locality before the movement began, other rural people who moved into the areas in order to combine farming activities with urban employment, and urban people who left the cities to take up residence in the more rural fringe areas. Thus, an intermingling of rural and urban people, ideas, values, and philosophies is taking place during the process of expansion. The areas involved in this change are large and contain sizable populations. They also exert considerable influence upon the character of the rural population and on the state's agriculture in general.

---

[1] The junior author is primarily responsible for the publication in its present form. He stated the hypotheses as they appear in this bulletin and did the subsequent statistical analyses and writing. The late Paul H. Price conceived of the study, furnished the general direction along which it proceeded, and directed the gathering of information from field surveys in the Baton Rouge fringe area. Price thus provided the basis upon which the present writer has worked.

Appreciation is extended to Dr. Frederick L. Bates for his valuable criticisms, and to Donald R. South and other research assistants who contributed so painstakingly to the detailed work necessary in such a study. Special thanks are due Professor Roland J. Pellegrin for continued encouragement and assistance in what would have otherwise been an impossible task.

The tasks of the study are to analyze the development of a basic part of the rural-urban fringe movement in Louisiana and to investigate its effects upon and implications for Louisiana's agriculture and rural life generally. An analysis of the fringe area of Baton Rouge has been chosen as the principal means of reaching these ends. Baton Rouge is particularly suitable for this role, since (a) it has a special importance in its own right as the capital city of the state, (b) it is on the edge of the fundamental French-Anglo-Saxon division of Louisiana and thus partakes somewhat of both cultures,[2] (c) in many geographic respects it is located between Shreveport and New Orleans (in regard to soils and location, for example), with consequent important implications for agriculture, and (d) it lacks the extreme population size of New Orleans and thus more closely resembles the state's other metropolitan areas. In reference particularly to the last point, however, it should be recognized that each city is in reality a unique entity. Though of course it will have many elements which it shares with other cities in general and with Louisiana cities in particular, Baton Rouge is, after all, Baton Rouge. Thus, one can generalize from Baton Rouge to the fringe areas of Louisiana or of the nation, but he must do so with caution.

2. Hypotheses

The importance of the study can be greatly enhanced by placing it within a larger context. To do this, two major hypotheses are offered: (1) The city is undergoing a fundamental change, such that it can no longer be considered the same type of phenomenon that it was two or three hundred years ago; (2) the "city" has come to dominate the rural areas to such an extent that no longer can the rural area be regarded as something which exists in its own right. In brief, then, the two hypotheses are: (1) The city is now a new kind of phenomenon, no longer to be interpreted in its old terms, and (2) because of the dominance of the city over the country, rural areas have also become qualitatively different.

The interrelations of these hypotheses are to be emphasized. The connection stems primarily from the nature of the material under discussion. Sociologists have found that the most meaningful explanation of urban and rural life is to be found not only in terms of the phenomena, themselves, but in terms of comparisons, and that the most meaningful comparisons are with their opposites. Cities, then, are to be contrasted with farms, and vice versa. When one speaks of something becoming more urban, he usually means that it is more urban in reference to rural life, that the city people are doing things more and more differently from their rural contemporaries and/or ancestors.

Turning specifically to the hypotheses, one may state that the newness of the city is in a major sense reflected in its greater integration with and dominance over the rural areas. The dominance, in turn, is an accompaniment and a resultant of other factors, to be discussed below. This interdependence means that it is difficult to separate a discussion of the two hypotheses, other than analytically. Comments made on one hypothesis automatically refer to the other in most cases. Such is the assumption, at least, in the paragraphs that follow. Remarks refer mainly to urban dominance, but, as indicated, the dominance is part of the newness.

---

[2] See Alvin L. Bertrand, *The Many Louisianas* (Baton Rouge: Louisiana Agricultural Experiment Station, Bulletin No. 496, June 1955), esp. Figs. 1 and 2.

In spite of the close connection, however, one must still speak of *two* hypotheses. The first, that of urban newness, stresses the urban part of the continuum. It means that the *cities are different*. The second hypothesis shifts attention to the opposing factor: rural areas have also changed. One hypothesis mentions the nature of the difference. The other shows one of the chief mechanisms. Several qualifications must be made to these hypotheses. First, although one can legitimately talk of the "dominance of the city," the inference should not be made that the city is causing a change in the rural areas. Rather, it is probably more useful to assume that both the city and the country are being influenced by something else, by a common denominator. An additional hypothesis is raised here (but cannot be tested in this monograph) – that the common denominator is industrialization.

When one considers the point, it becomes apparent that urbanization, of itself, has had little influence on the world, except as a kind of catalytic agent. Cities were first created not to achieve the heterogeneity and anonymity which characterize them, but most probably for economic and political (including defense) reasons. They were set up, as some have said, to serve the countryside. One can say more accurately, at least, they were set up to serve their people. Somehow certain cultures had developed in such a way that the invention of cities became useful. In the light of the above reasoning, cities have not grown because of urbanization–to thus contend is circular reasoning. They have grown because of developments in the culture as a whole.

Therefore, it would be more proper to talk of the dominance of industrialization on both the city and the rural areas. But since this is a more difficult thesis to demonstrate, we speak of the dominance of urban over rural areas, by-passing for the present study the question of exactly what is the nature of that which is doing the dominating. For present purposes, it is sufficient to speak of the city as only the center of domination.

The *trend* which has led and is leading to this domination is naturally of much earlier origin. More than a quarter of a century ago, R. D. McKenzie called attention to the growing integration of urban and rural areas. In sustaining any society, he argued, two kinds of labor are needed: "field" work, where the basic raw materials are acquired, and "center" work, where they are processed for consumption. He added, "Modern communications have so shrunken space that these center activities may be performed over wider areas than formerly."[3] It is this increasing extension of the city in space which is especially important to this study. In this extension are reflected the nature of the city's newness and its dominance over modern rural life.

---

[3] R. D. McKenzie, *The Metropolitan Community* (New York: McGraw-Hill Book Co., 1933), pp. 50 ff.

This study cannot claim to demonstrate conclusively either of the major hypotheses offered. More limited hypotheses will have to be sufficient. The claim can be made, however, that the information provided will aid in confirming (or disproving) the hypotheses. Only after continued studies in numerous fringe areas, of which Baton Rouge is one, will the hypotheses attain significant testing. We can prove or disprove the hypotheses insofar as they apply to the study area. We cannot do so for the U.S. as a whole or for the western world, and it is to these societies that the major hypotheses are directed. We can only attempt a contribution to the larger solution.

The specific hypotheses which the authors will seek to prove are, first, *that the rural and urban (farm and nonfarm) components of the Baton Rouge fringe represent a relatively homogeneous population,* and second, *that the urban influence on the fringe is dominant over the rural influence.* The first specific hypothesis is designed as one test of the first major hypothesis, and similarly, the second specific hypothesis tests the major hypothesis of urban dominance. To the extent that the metropolis includes within it agriculturalists who are not significantly different from other city dwellers, to that extent the old rural-urban, city-country distinctions are gone. Further, to that extent has the city become a different thing—it has come to include things with which it was once contrasted. Thus, the hypothesis of homogeneity becomes part of the test of the city as a fundamentally new kind of thing. The hypothesis of urban dominance extends this development to the rural areas.

The word "relatively" was employed in the first of the specific hypotheses because the homogeneity which is suggested is not that of an absolutely homogeneous urban world. The hypothesis says only that the urban and rural worlds will not be distinguishable. The city, as such, is founded on differences. It is this quality of differences, furthermore, which makes necessary the formation of one sub-hypothesis to that of homogeneity: *Farmers are expected to differ from urban people in those traits which are most closely associated with their occupation.* This hypothesis is consistent with the fact that urbanization rests on an extensive division of labor. Urban jobs differ from one another. It is only logical, therefore, to expect that the traits which are most directly connected with the farmer's job, i.e., those which grow from his job, will remain different. This statement should not cause one to overlook the fact that it is in practice difficult to separate into logical, air-tight compartments the various behavior patterns which make up human social living. Job patterns are related to family patterns which are related to educational patterns, etc. The boundary which marks the place where one pattern stops and the other starts is not always easy to recognize. Consequently, one can make only rough predictions about which traits will differ and which will be similar.

The significance of these hypotheses, especially that of the newness of the city, may not be readily apparent to those of us who have grown with cities. One might well ask, have the cities not always absorbed the farmers living on their fringes? The answer to such an apparently simple question is by no means easy, mainly because only in recent times has mankind developed an adequate system of "social bookkeeping." Consequently, one cannot give percentages or similar measurements of rural and urban life for past centuries. Indeed, he cannot do so with accuracy for most of the world today. However, though data are far from exact, some evidence can be cited.

Generally, one may say that the city has not grown primarily by incorporating the neighboring farms. Such incorporation has occurred, of course, but there is no evidence that it could have approached the importance it bears today. Two types of evidence contribute to this conclusion: first, cities have generally been rather narrowly confined with respect to their areal limits and, second, they have only recently changed their status from that of urban outposts in a rural world.

Earlier cities have been confined to rather small land areas, if only because transportation difficulties limited the distance to which one could journey to and from work. Cities were not only limited but were sharply distinguished from the surrounding countryside, as is attested by the city walls of the older European and Asian cities, and even some cities in the United States. The need for walls has now gone, but the separation from the countryside has not. Particularly where transportation is still limited, the break between the rural and the urban worlds is abrupt. For example, within five miles from the city of Sofia, Bulgaria, one could still draw a stubborn argument from the Balkan peasant of the 1930's as to whether the earth was round or flat. These people knew the city, to be sure, and even journeyed to it perhaps several times in a month. But city ways were suspect. The peasant's life was governed by the needs of agriculture, and he tenaciously resisted anything else.[4] These remarks will attain even greater significance as the present study progresses when one realizes that most of the sample areas in the rural-urban fringe of Baton Rouge, a city several times *smaller* than Sofia, extend *beyond* a radius of five miles from the city.

It may be gathered from the above discussion that territorial extension, alone, is not the most important feature of the present hypotheses, though it is certainly basic. The significance of the questions which this study attempts to answer rests in the fact that the city has come to extend itself and to include *within* its social boundaries the farm population. We have the phenomenon, now, if the hypotheses can be verified, of farmers who are city-folk. This statement is not referring to the fact that farmers live in cities.[5] It is describing the condition wherein farmers are losing the way of life which has been associated with farming and are assuming the city or urban way of life. Such a condition stands in contrast to the type of situation found in other parts of the world and, as we shall see, it stands in contrast to history.

---

[4] Irwin T. Sanders, *Balkan Village* (Lexington: The University of Kentucky Press, 1949), esp. pp. 18-19. Bulgaria is but one example. For others, see also S. C. Dube, *Indian Village* (Ithaca, N.Y.: Cornell University Press, 1955), and Donald Pierson, *Cruz Das Almas, A Brazilian Village* (Washington, D.C.: U.S. Government Printing Office, Smithsonian Institution, Institute of Social Anthropology, Publication No. 12, 1951). The distances between the villages and the cities vary, but the principle is the same. Within a relatively short distance from major world cities can be found examples of the most extreme of the world's rural population.

It was also noted, above, that cities were new as centers of dominance, that formerly they had been urban outposts in a rural world. One must realize that mankind has only recently come to live in cities. Of course, the existence of cities extends back thousands of years, but their numerical importance is new. So new is this development, in fact, that most of the world is yet to be touched. The bulk of mankind is still rural.[6] Even in the United States, one of the more urbanized countries of the world, three-fifths of the nation's population was rural as late as 1900, and only since 1920 have more than one-half of the people been classified as living in urban areas. Thus, cities formerly could not be dominant, if only because they lacked manpower. Throughout history, of course, cities have dominated certain types of art and literature because of their possession of superior communication facilities. But cities have nonetheless failed to claim the life of a majority of mankind, either today or in times past. Wherever it does exist, sociologically speaking, the dominance is new.

And one may go a further step. The hypotheses claim that the city dominates the rural areas. But elsewhere in the world one finds cities dominated by the rural world. Timbuctoo, for example, is a rural city—or, more precisely, it is a city which is close to the rural end of the urban-rural spectrum.[7] As one urban sociologist noted, not only do cities in many parts of the world fail to change the rural traits and customs of their hinterland, but the cities, themselves, will have a simple division of labor and their sub-groups will be unified by kinship ties and traditional norms.[8]

The hypotheses to be investigated in this study, then, seek to establish that the city is not merely reacting to rural influences. It has become, instead, a source of change which is reshaping the rural life. It is not the city which is only somewhat less rural. It is the rural areas which are becoming very much urban. The city is reaching out in its growth. The reaching out is new, at least in the degree to which it is occurring. And the city is dominating that which it is reaching.

---

[5] To be completely accurate, the statement would also have to disregard the negligible proportion of the farm population residing inside the city limits—that which the U.S. Census calls the urban-farm population. In 1950, approximately three persons in every thousand city dwellers fell within the class of urban-farm. Thus, the modern farmer does not typically live within the city limits. Our focus is, instead, on those who reside on its fringes.

[6] T. Lynn Smith, *The Sociology of Rural Life,* 3rd ed. (New York: Harper & Bros., 1953), pp. 42-43.

[7] Horace Miner, *The Primitive City of Timbuctoo* (Princeton: Princeton University Press, 1953).

[8] Rose Hum Lee, *The City* (Chicago: J. B. Lippincott Co., 1955), pp. 5-6.

Since the city is seen as the dominant force in the most rural areas of the fringe, it is easy to overlook the importance of agriculture in this analysis. Regardless of the *source* of the influences which are being studied, it should not be forgotten that a central purpose of this bulletin is to show the changes which are important for rural life. The hypotheses are no distraction to this purpose. They even aid it. Part of the analysis will be focused directly on changes in the kind of agriculture practiced in the fringe. In doing so, not only is illumination given to the agricultural picture. The study is in this manner enabled to probe more deeply into the more extreme influences of urban dominance than would be the case in investigating any other cultural feature, since agriculture has historically been at an opposite pole to the city and urbanization. And, to the extent that the city is coming to dominate the country, or the center is dominating the field, it would be to the benefit of agricultural people to be made aware of the change. Admittedly, it may not be pleasant to view the possibility that some rural ways and values may become the victims of the changes described herein—or that some have already become so. But the facts are still there. Knowing of them, however, can at least provide warnings of what to expect. The present state of sociology is akin to that of meteorology in this connection. Perhaps we cannot tell how to control the change, but if we can predict some of it, that in itself is an accomplishment.

Note also that these hypotheses do not spell the doom of agriculture. One might as well speak of the doom of food. Rather, they point to fundamental changes affecting rural people.

3. Characteristics of the Sample

This study is based almost exclusively on the results of a sample taken from the rural-urban fringe area of East Baton Rouge Parish. The sample areas employed[9] are shown in Figure 1. The reason for using a sample and the cautions necessary in that connection are discussed below.

A total of 527 interviews was taken, 3 of which had to be discarded for a large part of the study because of inadequate information. Of those who were contacted in the interview and who specifically answered the questions (i.e., the "respondents"), 25.6 per cent were males and 74.4 per cent were females. Notice that the adult population in this area in 1950 was composed of equal proportions (50.0 per cent) of males and females. Thus, the sample of respondents is not representative for the sexes of the total population of the fringe area. What happened, of course, is that a "bias of accessibility" was at work. Housewives are more apt to be at home and thus are more likely to be contacted by interviewers than are their husbands. Confirmation of this view is received when the farm

---

[9] The procedure used in choosing the sample is described in Earl E. Houseman and T. J. Reed, *Application of Probability Area Sampling to Farm Surveys* (Washington: U.S. Department of Agriculture, Agricultural Marketing Service, May 1954, Agriculture Handbook No. 67).

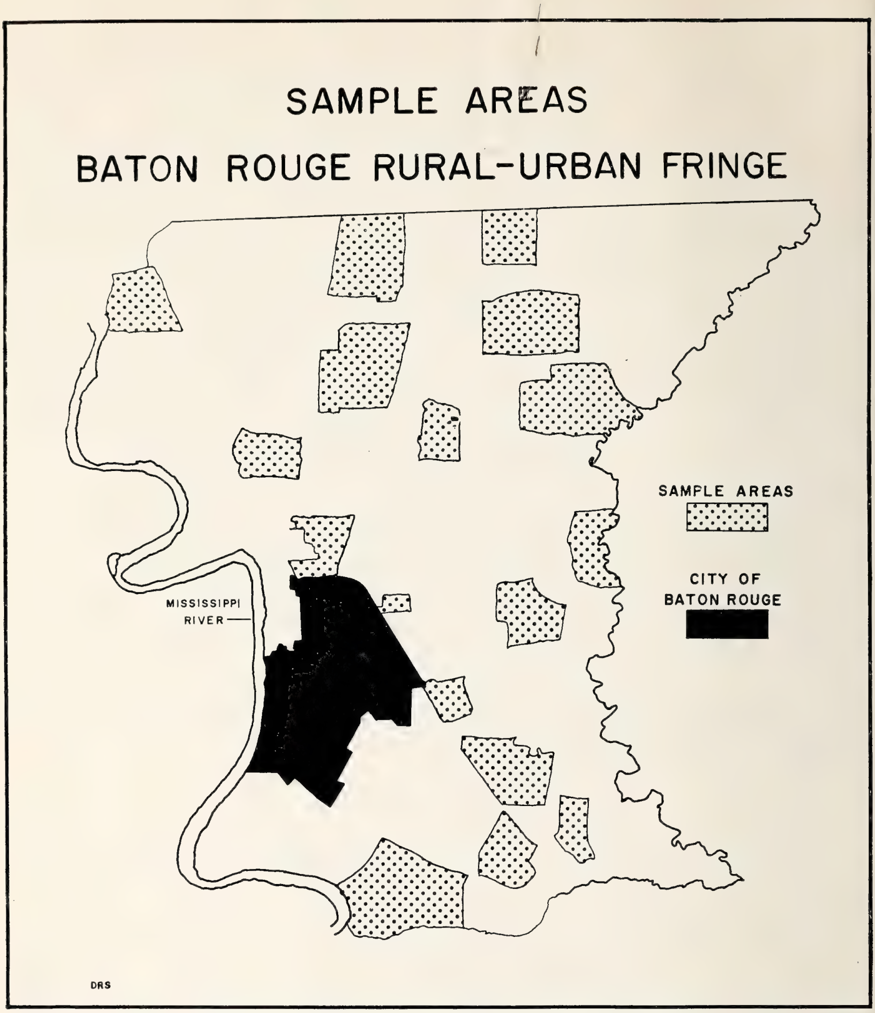


FIGURE 1.—Sample Areas in the Rural-Urban Fringe of East Baton Rouge Parish, 1957.

population is examined. There, where males are more often home, more males were contacted.

Accordingly, this study is one of households and families rather than one of individuals. Most of the questions are worded in this manner—we are interested in the activities of the family members, of the household members, rather than in the respondent. Sociologically, of course, this is no handicap. The student of society is more interested in the group patterns of behavior, in the more established routines, than he is in individual peculiarities.

In brief, then, the sample is not one that is representative of each individual in the fringe. It is representative only of the households and families there.

As can be seen in Table 1, most of the fringe dwellers did not live on farms. For purposes of simplicity, these people will be referred to as urban dwellers, though it is admitted that we are referring here to a way of life rather than a place of residence. Strictly speaking, of course, these people are suburbanites, but then, so also are the farmers. On the other hand, we cannot call these people city dwellers, since for the most part they inhabit no city (in the legal sense, of course). Therefore, the terms "urbanite" or "urban" dwellers are used in this manuscript as a synonym for "nonfarmer."

Table 1 also reveals that most of the fringe dwellers are white, although a substantial proportion are Negroes (technically speaking, "nonwhite," but there are no Asiatic families in the sample).

The sample, then, is mainly composed of urban, white persons, although farmers and Negroes are also represented in significant numbers. These two breakdowns, together with that of sex, are basic to the study and are used extensively. The farm-urban distinction is employed, of course, because it is central to the nature of the problem being considered. In addition, race is such a fundamental social distinction in all Southern cities that it is necessary that the data be handled separately for each race. So powerful are the social forces which are at work in this area, and so strongly do these forces influence human behavior, that most descriptions of Southern life do, in fact, turn out to be also racial descriptions. We therefore want to consciously "build" racial descriptions into the study—to bring them out into the open where we can be aware of them, where they can be watched, and, when necessary, where they can be either held constant or at least controlled.

4. The Nature and Use of Samples

The size of the sample may cause some readers to wonder if it is not "too small." Actually, the developments in modern statistics make possible the use of small samples to such a point that the interpretation is virtually the same as that from large samples. This point can be made more em-

TABLE 1.—Rural-Urban Residence of the Sample Population, by Sex and Race, Baton Rouge Fringe, 1957

	Per Cent				
	White	Negro	Total	Total Farm-Urban	Number
Farm	100	100	100	19	101
Male	41	39	41	. .	41
Female	59	61	59	.	60
Urban	100	100	100	81	423
Male	26	20	22	. .	93
Female	74	80	78		330
Total	100	100	100	100	524
Male	26	25	26	. .	134
Female	74	75	74	. .	390
Total White-Negro	78	22	100		
Number	406	118	524		

phatic: for all practical purposes, *the size of a sample has little to do with its accuracy.* In fact, a large sample that is not representative of the population is, numerically speaking, in greater error than a small sample that is representative. The more important question concerns the manner in which the researcher uses his sample. In fact, were it not for the ability to the "Technical Appendix," where more detailed comments on statistical of scientific endeavor could never appear at all.

The type of analysis that makes possible the use of small samples depends on the application of *probability statistics.* Since many readers of this bulletin have had no experience in this area, the complete mathematical supports and calculations for the statistics are omitted in the body of this bulletin. The reader who is interested in greater precision may turn to the "Technical Appendix," where more detailed comments on statistical analysis are given. The present and following discussions are concerned only with practical applications.

Probability.—A brief discussion of the meaning of probability and chance is important for a more complete understanding of this bulletin. As is indicated earlier, the basic question for which an answer is being sought here is the degree of homogeneity between the urban and rural populations of the fringe. How like each other are they? Are the differences important? We are thus attempting to measure how "pure," or more precisely, how homogeneous the two populations (urban and rural) are. It is important to remember in this connection that nothing is either homogeneous or heterogeneous. Whatever is said about the homogeneity of the two populations, it will have to be described in terms of more or less of this quality, or of its opposite, heterogeneity.

The standard customarily employed by statisticians when discussing purity and homogeneity is that of chance or, if you will, accident. If the people of two populations differ from one another only by small amounts or only in terms of accidental variations, the two populations are then assumed to be only a single population. This population is accordingly described as "pure," or homogeneous, etc., in reference to the trait being measured. For this reason, we will speak of chance, insignificant, accidental, random, or unimportant variations whenever our urban and rural populations approach each other rather closely. Whenever these terms are used, the two populations are construed to be similar. On the other hand, when the populations diverge (according to accepted statistical criteria), then we talk of differences not due to chance, or differences which are significant, or which are not accidental, etc. In such cases, in spite of the fact that we may or may not know the reason for the differences, the differences are real and we would expect to find them if we took other samples of the total population.

Chi Square: The Measure of Probability.—Fortunately, there have been developed statistical measures of the degree of homogeneity in small samples. One of the simpler of these measures is known as *chi square,* usually designated by its Greek lower-case letter, χ^2. Except as noted below, the smaller chi square becomes, the smaller are the differences between the populations in the sample, the more homogeneous the sample, and the more differences are due to chance. The larger the chi square, the less differences are due to chance and the more heterogeneous the sample.

The precise interpretation of chi square can be done by means of statistical tables that have already been prepared. The only additional information needed to "read" such tables is the concept of *degrees of freedom*, symbolized by "df." The degrees of freedom are directly proportional to the number of entries or cells in the statistical table that is used to compute chi square (similiar in many respects to the tables used in this report). The more variables under investigation, the greater the number of cells in the chi square table and the more degrees of freedom appear. More important (and this is the exception noted in the preceding paragraph), as the degrees of freedom are increased, the numbers assigned to chi squares *of the same value* tend to increase. Thus, a chi square of 3.84 with one degree of freedom is equivalent to a chi square of 5.99 with two degrees of freedom which is equivalent to a chi square of 9.84 with three degrees of freedom, etc.

For many readers of this report, this information is all that is needed: degrees of freedom (df) are used in reading the interpretation of chi square from a special statistical table. In fact, degrees of freedom are only given for the benefit of the statistically oriented. More accurate explanation is not needed, since the interpretation of each chi square is provided in the tables of this report where they appear. This interpretation is referred to as the *Probability* (represented by P) of an event occurring by chance. The closer P is to 1.00 (it is always smaller than 1.00), the more chance is likely to be responsible for the differences. The closer P is to zero, the less chance is likely to explain the observed differences and, consequently, the more "significant" are any differences which occur. P is seldom given as any one number. Rather, P is described as occurring somewhere between two numbers, Accordingly, a P of .70-.50 means that the statistics described in the given table could have occurred by chance between 70 and 50 per cent of the time. Obviously, in such cases, chance is "at work," and the sample is homogeneous for the given measure. On the other hand, a P of .05-.02 means the differences in the statistics are too large to have occurred by chance. Chance differences in such cases would occur only between 5 and 2 per cent of the time, and the sample is therefore heterogeneous and composed of real differences.

For purposes of simplicity, a P of .10 is taken as the dividing line between chance and non-chance differences. Whenever P is greater than .10 (i.e., .30, .50, .80, etc.), then the sample is homogeneous—the statistics are not really too different from each other. Whenever P is less than .10 (i.e., when P is .05, .01, .001), then for practical purposes chance is not at work and the statistics in the sample are significantly different from each other.

In terms of the objectives of this report, *when P is greater than .10 the rural and urban people are similar to each other in terms of the traits that are being measured. When P is smaller than .10, the farm and urban people are different.*

This rule is a simplification, but one which is designed primarily to guard against letting one's personal prejudices influence his judgment By accepting a fixed standard of homogeneity, we lessen the risk o changing our judgment to fit our preconceived "needs." In order to make this rule most effective, we must adhere to it rigorously, in spite of frequent temptations.

It should also be remembered that when the writer says that chance is at work such-and-such a per cent of the time, he means that probably such is the case. Chance could *always* be affecting any measurement made by any scientist. No one ever really knows. But we can say what we would expect most of the time. The proportions (i.e., P) which are given with each statistic is our way of saying how often we would expec such differences to occur by chance, that is, probably.

5. Plan of the Study

Most of the traits investigated are treated in the following section "The Merging Pattern." These are the traits that should not differ between the farm and urban segments of the fringe population if the two have merged. If complete homogeneity does not prevail, the corresponding hypothesis is not to that extent disproved. In the first place, one should bear in mind (as has been indicated above) that the urban world is not one which is completely homogeneous. But more important homogeneity can be looked on as a quantitative subject, as something which varies in degree. It is so regarded in this study. Therefore, the more similar traits found, the more the hypothesis is proved.

A distinction is made between those traits which the authors expec to find different and those which could merge. The section "Expected Differences" deals with these traits. For the most part, as shown in the section on "Hypotheses," these traits are those which are closely tied to the job, such as distance (or time) used in traveling to work, the nature of the occupation, and so on.

The influences which suburbanization have exerted on agricultura practices are discussed in "The Impact on Fringe Agriculture." In this section, attention is shifted from rural-urban differences to the changes that have come about in one of the most central aspects of rural life The hypothesis of urban dominance receives one of its strongest tests here.

The study concludes with an over-all "Assessment of the Rural Urban Differences," and a discussion of the "Implications" this study has for other areas. In this last section, the hypotheses submitted in the introduction are carefully examined in an effort to determine the extent to which they have been supported.

The "Technical Appendix" provides the qualifications specialists will need in forming their own opinions.[10]

II. THE MERGING PATTERN

Most of the effort in this bulletin is directed toward discussing homogeneity in the fringe area. By doing so, the hypothesis of rural-urban homogeneity is tested directly and much of the groundwork is established for testing the hypothesis of urban dominance.

Three general types of traits are examined. The first concerns the rules by which people operate their social groups. These rules are called "institutions," and they are found associated with most of the groups with which we are familiar. The institutions that are studied here include those of the family, education, and income.

The second type of trait deals with the activities and interactions (social contacts) in which people engage, including those connected with institutions. The *location* of these activities and interactions is the most basic problem here. Where do the people do their shopping, where are their schools and churches, etc.? If all of these things are in the fringe, then the fringe obviously has little to do with Baton Rouge and there can be little direct urban dominance, in spite of what other homogeneity there may be.

The final type of trait investigated is as important as any other, if not more so: attitudes and values. These are at the same time the motivators to activity and interaction and the reflection of the influences which motivate people. Thus, people do things because of their attitudes and values, and these in turn reflect the feelings of people when other things motivate their behavior. As such, a merging of these types of traits is basic to any study of social behavior.

1. Institutional Patterns

The Family.—Most of the adult suburbanites are married. Proportions never drop below five-eighths (see Table 2). But, at least for the males, the farm and urban populations are significantly different. The unmarried suburban farmers (i.e., those who are single, widowed, separated, or divorced) constitute 27 per cent of the population, whereas only 8 per cent of the urban men are unmarried.

There are significant differences also in the *total* population of women, but the proportions are in the reverse order from those of the men: more farm women are married than is true of urban women (94 as contrasted with 87 per cent). There are enough women in the sample, however, to permit the white women to be studied separately, and here the reason for the differences becomes more apparent. Farm and urban white females are married to about the same extent. Only chance differences are apparent. The significant differences, therefore,

---

[10] In fact, it is recommended that the professional sociologists examine the appendix before proceeding to the rest of the work.

TABLE 2.—The Adult Married Population, by Sex, Residence and (For Females) Rac

	Per Cent						
	Married	Other	Total	Number	χ^2	df	P
Male							
Farm	73	27	100	41			
Urban	92	8	100	60	6.23	1	.02-.0
Female							
Farm	94	6	100	93			
Urban	87	13	100	330	2.90	1	.10-.0
White	92	8	100	336			
Negro	76	24	100	87	17.69	1	<.001
White Female							
Farm	93	7	100	76			
Urban	92	8	100	260	0.27	1	.70-.5

TABLE 3.—Total Adult Population Ever Divorced, by Residence

	Per Cent						
	Yes	No	Total	Number	χ^2	df	P
Farm	5	95	100	97			
Urban	7	93	100	421	0.39	1	.70-.5

must lie in the Negro population. (This interpretation could also apply to the male population.)

Farmers and urbanites do not differ in the extent to which they were ever divorced (Table 3). Divorce is equally rare in either case Therefore, the married population of the fringe tends to be homogeneous for the white women, but there is homogeneity at least to some extent for the entire population.

Family composition represents an area in which one would expec rural differences to be most resistant to change. In reality, the family embodies within it most of the aspects of the *way of life* of rural living And the differences between the farm and urban residents in the fringe are clear and marked. Except in the Negro population where homogeneity does prevail, farm families tend to be older than their urban counterparts (see Table 4). The number of children in the farm families is also greater (Table 5), and both husbands and wives tend to be older (Table 6). Accordingly, one may conclude that no matter how far the transition from rural to urban modes of living has prevailed, i is not complete. These sets of differences alone are sufficient to warrant that conclusion. This statement, however, should not be taken as a denial of the numerous similarities which have appeared, as have been noted and as will be noted below. Remember, even in this area of family composition, the Negro population is homogeneous in some respects, and there is a noticeable degree of homogeneity in the related area of marital status for the total population.

TABLE 4.—Type of Family Composition, by Race and Residence

	Per-Cent								
	Pre-school and Young School	Old School and Post-school	Middle-aged	Old	Total	Number	χ^2	df	P
White									
Farm	42	19	24	15	100	68			
Urban	67	15	8	10	100	318	18.44	3	$<.001$
Negro									
Farm	26	29	19	26	100	31			
Urban	43	17	11	29	100	84	4.92	3	.20-.10

Definitions:

Preschool: Oldest child is less than 6 years old.

Young School: Has preschool children, school-age children, or all children in school.

Old School: Children in school ages and children who have completed education.

Postschool: All children have completed education.

Middle-aged: All adults, head is from 40 to 64 years of age.

Old: All adults, head is 65 years of age and over.

TABLE 5.—Number of Children Ever Born and Living, by Race and Residence

	Per Cent										
	0	1	2 & 3	4 & 5	6 & 7	8 & Over	Total	Number	χ^2	df	P
Farm	9	17	34	14	13	13	100	95			
Nonfarm	11	17	42	19	6	5	100	418	13.19	5	.05-.02
White	8	18	46	17	6	5	100	396			
Negro	18	16	24	19	12	11	100	117	28.23	5	$<.001$

TABLE 6.—Age of Husbands and Wives, by Race and Residence

	Per Cent							
	Under 45	45-59	60 and Over	Total	Number	χ^2	df	P
HUSBANDS								
White								
Farm	36	36	28	100	69			
Urban	60	26	14	100	251	14.06	2	$<.001$
Negro								
Farm	14	50	36	100	28			
Urban	48	23	29	100	66	11.12	2	.01-.001
WIVES								
White								
Farm	52	34	14	100	64			
Urban	72	19	9	100	329	10.83	2	.01-.001
Negro								
Farm	30	44	26	100	27			
Urban	55	20	25	100	85	7.50	2	.05-.02

TABLE 7.—Years of Schooling Completed, Husbands and Wives, by Race and Residence

	Per Cent								
	Under 5	5-8	9-12	13 and Over	Total	Number	χ^2	df	P
HUSBANDS									
White									
Farm	4	29	40	27	100	70			
Urban	6	19	45	30	100	313	1.57	2*	.50-.3
Negro									
Farm	59	30	4	7	100	27			
Urban	39	48	11	2	100	66	3.04	1*	.10-.05
WIVES									
White									
Farm	5	20	45	30	100	64			
Urban	4	20	56	20	100	332	3.38	3	.50-.3
Negro									
Farm	30	52	11	7	100	27			
Urban	35	45	19	1	100	85	0.48	2*	.80-.7

*Degrees of freedom do not correspond to the number of cells in the percentage table. Computation of χ^2 was done with combined cells.

Education.—The urban and farm populations are particularly homogeneous with respect to education. Only the Negroes display some differences, and these differences are not great. They could occur by chance between 5 and 10 per cent of the time (see Table 7).

Most of the adult white population (specifically, husbands and wives) have completed the eighth grade, though most have not finished high school. Even so, more than one-fourth have completed some college work or the equivalent. Negroes do not have the same attainment. Most have gone no farther than grammar school. The proportion of functional illiterates (those with less than five years of schooling) is also substantially higher, ranging from 30 to 59 per cent, as compared with the white range of 4 to 6 per cent.

The importance of this homogeneity is great. Education is one of the chief urbanizing influences in this country, and the fact that for most of the population—the whites—its level is high in addition to being similar for both the farm and the "city" population points to the pervasiveness of urbanization in the Baton Rouge metropolitan area.

Economics.—Of the two measures used in the economic realm (see Tables 8 and 9), one shows tendencies toward homogeneity and the other does not. In terms of income, the white population is rather heterogeneous, though again the probability of accidental differences is somewhat high. The differences could be accounted for by chance 5 to 10 per cent of the time. The Negro population, on the other hand, shows a high degree of homogeneity between its urban and farm populations.

The differences between the races in reported income is marked. The majority of whites earned between two and ten thousand dollars, whereas most Negroes reported incomes of less than two thousand.

TABLE 8.—Income, by Race and Residence of Respondent

	Per Cent								
	Under $2,000	$2,000-4,999	$5,000-9,999	$10,000 and Over	Total	Number	χ^2	df	P
White									
Farm	8	37	33	22	100	63			
Urban	10	30	48	12	100	314	7.46	3	.10-.05
Negro									
Farm	67	22	4	7	100	27			
Urban	59	33	8		100	81	0.47	1*	.80-.70

*Degrees of freedom do not correspond to the number of cells in the percentage table. Computation of χ^2 was done with combined cells.

TABLE 9.—Home Tenure Status, by Race and Residence of Respondent

	Per Cent							
	Owns	Buying	Rents and Other	Total	Number	χ^2	df	P
White								
Farm	72	17	11	100	70			
Urban	42	40	18	100	336	21.55	2	<.001
Negro								
Farm	71	10	19	100	31			
Urban	51	6	43	100	87	3.91	1*	.05-.02

*Degrees of freedom do not correspond to the number of cells in the percentage table. Computation of χ^2 was done with combined cells.

There is even more heterogeneity in home tenure than there is homogeneity in income. Farmers, whether Negro or white, own their homes in significantly greater proportions than do the fringe's urban residents. This difference occurs in spite of the fact that home ownership in the suburbs is generally high: over two-fifths of all categories shown in Table 9 are home owners. Note further that Negroes and whites differ markedly. Fewer Negroes are *buying* their homes and many more are renters than is true of the white population.

There is a difference between income and home tenure which in all likelihood has an important influence on this study. Income is a more urban commodity. Home tenure tends to measure more rural tendencies. The typical city dweller is not attached to the land—the farmer is. Thus, again, it is not surprising to find farmers more persistent in retaining their differences in home-property patterns. The comments made above in the section on the family therefore apply also to a great extent here.

2. Activities and Interaction

The primary aim in speaking of activities and interaction in the fringe area is to show the differences in the amount of integration which the fringe residents have with Baton Rouge. The major point here is that, although there will be varying degrees of integration in variou spheres of activity and interaction, the urban and farm residents wil not differ significantly within these spheres. The areas covered include economic activities, use of health facilities, membership in civi and social organizations, use of schools and churches, and recreationa behavior. The basic question concerns the location of these activities For statistical purposes, the locations generally had to be divided int those which were situated in Baton Rouge and those situated in "othe areas." The suburban town of Zachary occasionally attains enoug numerical importance to deserve special mention.

There appear to be no important differences between the urba and farm populations with respect to the purchase of food and clothing and important differences arise with respect to the purchase of medicines only in the white population (Table 10). Foods and medicine are relatively decentralized—proportions shopping in Baton Rouge range from 41 to 68 per cent. This situation is to be contrasted wit the centralization of clothing purchases in the city of Baton Rouge— over 70 per cent of all categories of respondents conformed to thi practice.

TABLE 10.—Location of Places Where Respondents Purchased Food, Clothing, an Medicine, by Race and Residence

	Per Cent							
	Baton Rouge	Zachary	Remaining Areas	Total	Number	χ^2	df	P
FOOD								
White								
Farm	59	12	29	100	92			
Urban	67	9	24	100	420	2.41	3*	.50-.30
Negro								
Farm	25	19	56	100	36			
Urban	35	17	48	100	97	3.75	3*	.30-.20
CLOTHING								
White								
Farm	82	11	7	100	83			
Urban	88	5	7	100	365	4.21	2	.20-.10
Negro								
Farm	70	14	16	100	37			
Urban	72	14	14	100	98	0.08	2	.80-.70
MEDICINE								
White								
Farm	60	32	8	100	72			
Urban	67	16	17	100	360	11.75	2	.01-.00
Negro								
Farm	45	36	19	100	36			
Urban	41	41	18	100	95	0.26	2	.70-.50

*Degrees of freedom do not correspond to the number of cells in the percentage table. Computation of χ^2 was done with additional cells.

The concentration is even more evidenced, as would be expected, in the purchase of such items as furniture and appliances. Usually, over 90 per cent of the respondents shopped for these items in Baton Rouge (Table 11). Automobile services, on the other hand, are quite decentralized, with the city never coming in for more than half of the reported trade. More important for all of these items, there was displayed marked homogeneity between the farm and urban segments, i.e., no significant differences were uncovered (Table 11).

Nowhere except in recreational behavior (see below) do the activities of urban and farm suburbanites differ more than in their use of banking and insurance institutions. Although most of the suburban population prefers Baton Rouge, the farm population prefers the remaining areas to a greater extent than does the urban population (Table 12). Only the Negro population becomes homogeneous, and this homogeneity is only with respect to the places where they obtain insurance. Even so, two points should be noted: First, the homogeneity is not marked (such a sample could have occurred by accident between 10 and 20 per cent of the time), and even though homogeneity does

TABLE 11.—Location of Places (Baton Rouge or Elsewhere) Where Respondents Purchased Furniture, Appliances, and Automobile Services, by Race and Residence

	Per Cent						
	Baton Rouge	Other Areas	Total	Number	χ^2	df	P
FURNITURE							
White							
Farm	91	9	100	68			
Urban	92	8	100	338	0.01	1	.95-.90
Total							
Farm	90	10	100	101			
Urban	92	8	100	413	0.22	1	.70-.50
APPLIANCES							
White							
Farm	86	14	100	72			
Urban	90	10	100	339	0.94	1	.50-.30
Negro							
Farm	77	23	100	31			
Urban	86	14	100	71	1.07	1	.50-.30
AUTOMOBILE SERVICES							
White							
Farm	40	60	100	77			
Urban	50	50	100	352	5.75	3*	.20-.10
Negro							
Farm	24	76	100	25			
Urban	39	61	100	49	1.57	1	.30-.20

*Degrees of freedom do not correspond to the number of cells in the percentage table. Computation of χ^2 was done with additional cells.

TABLE 12.—Location of Places (Baton Rouge or Elsewhere) Where Respondents Obtained Insurance and Banking Services, by Race and Residence

	Per Cent						
	Baton Rouge	Other Areas	Total	Number	χ^2	df	P
INSURANCE							
White							
Farm	84	16	100	69			
Urban	93	7	100	324	6.17	1	.02-.01
Negro							
Farm	64	36	100	25			
Urban	77	23	100	62	1.66	1	.20-.10
BANKING							
White							
Farm	71	29	100	70			
Urban	67	33	100	296	5.72	1	.02-.01
Total							
Farm	71	29	100	79			
Urban	82	18	100	328	4.61	1	.05-.02

prevail, the differences are of the same nature as those in the other segments of the population (including the use of banking facilities).

In general, one would be safe in concluding that there is a real difference between the urban and rural fringe inhabitants in their use of money-related institutions. This difference is perhaps a result of the tendency of habits formed under earlier conditions to persist. It is known that urban people, when migrating to the suburbs, tend to maintain some of their former city contacts.[11] Apparently, the financial institutions tend to be involved in this group of persistent behavior patterns. This persistence, however, is to be contrasted with the similarity in *amount* of income possessed by the farm and the urban residents.

The use of medical and dental facilities appears to resemble fairly closely the behavior connected with more purely economic activities. Whites tend to use Baton Rouge to a rather great extent, whereas Negroes tend to use other areas (Table 13). Further, the white population of the fringe shows some differences in the use of medical facilities and only a fair degree of homogeneity in the use of dental services. The urban and rural Negro populations, on the other hand, tend to be quite similar in their behavior. Briefly, then, there appear to be definite similarities between urban and farm populations in the use of health facilities, although the white population tends to become different at least in some respects.

Only a minority of the fringe residents belong to civic and social organizations (Table 14). This statement is as true of the urban as it is

---

[11] See Noel P. Gist, "Ecological Decentralization and Rural-Urban Relationships," *Rural Sociology*, Vol. 17, No. 4 (Dec., 1952), pp. 328-335.

TABLE 13.—Location of Places Where Respondents Obtained Medical and Dental Services, by Race and Residence

	Per Cent							
	Baton Rouge	Zachary	Other Areas	Total	Number	χ^2	df	P
MEDICAL SERVICES								
White								
Farm	75	20	5	100	75			
Urban	74	13	13	100	366	5.51	2	.10-.05
Negro								
Farm	43	36	21	100	33			
Urban	38	44	18	100	91	0.57	2	.50-.30
DENTAL SERVICES								
White								
Farm	77	23		100	70			
Urban	84	16		100	320	2.19	1	.20-.10
Negro								
Farm	58	26	16	100	31			
Urban	48	30	22	100	73	2.05	2	.50-.30

TABLE 14.—Number of Civic and Social Organizations to Which Various Family Members Belong, by Race and Residence

	Per Cent						
	None	One or More	Total	Number	χ^2	df	P
HUSBANDS							
White							
Farm	61	39	100	70			
Urban	61	39	100	336	0.00	1	>.95
Negro							
Farm	65	35	100	31			
Urban	79	21	100	87	2.73	1	.10-.05
WIVES							
White							
Farm	67	33	100	70			
Urban	65	35	100	336	0.61	1	.50-.30
Negro							
Farm	71	29	100	31			
Urban	70	30	100	87	0.00	1	>.95
CHILDREN							
White							
Farm	79	21	100	70			
Urban	84	16	100	336	1.18	1	.30-.20
Total Children							
Farm	84	16	100	101			
Urban	85	15	100	423	0.10	1	.80-.70

of the farm population and applies particularly to the wives and children. There are no important differences between the latter segments. Only Negro husbands show slight differences—a larger proportion of urban than rural Negro husbands are "joiners." In contrast, farm and urban husbands in the white population show identical patterns.

Because of the small number of members, analysis of the location of organizations is made difficult. Total populations must be described instead of analyzing farm and urban populations separately for each race. Nonetheless, the differences are clear enough to permit some generalizations.

For the total urban and farm populations, there are no significant differences in the locations of their organizations (Table 15). The civic and social organizations of the husbands tend to be evenly divided between Baton Rouge and the other areas (with probably a tendency to favor Baton Rouge). Wives and children distribute their membership more in the fringe areas. Significant differences appear, however, in the white and Negro populations. Few Negroes belong to oranizations that have their location in the city of Baton Rouge. It could well be, therefore, that there are differences betwen the urban and rural segments of the Negro population in respect to the location of their organizations, though the numbers are too few to permit testing for the importance of the differences in this report.

In view of the well-established patterns of school assignments, the higher degree of similarity between farm and urban children in the location of their schools is hardly surprising (Table 16). Attendance in Baton Rouge is, of course, not common.

Church attendance differs markedly between the white and Negro suburbanites (Table 17). Not only do the white residents find their churches

TABLE 15.—Location of Civic and Social Organizations to Which Various Family Members Belong, by Race and Residence

	Per Cent						
	Baton Rouge	Other Areas	Total	Number	χ^2	df	P
HUSBANDS							
Farm	50	50	100	36			
Urban	64	36	100	155	2.55	1	.20-.10
White	68	32	100	168			
Negro	17	83	100	23	21.77	1	<.001
WIVES							
Farm	31	69	100	35			
Urban	37	63	100	152	0.34	1	.70-.50
White	40	60	100	154			
Negro	18	82	100	33	5.39	1	.05-.02
CHILDREN							
Farm	35	65	100	17			
Urban	41	59	100	58	0.20	1	.70-.50

TABLE 16.—Location of Children's Schools, by Race and Residence of Respondent

	Per Cent						
	Baton Rouge	Other Areas	Total	Number	χ^2	df	P
White							
Farm	34	66	100	41			
Urban	32	68	100	211	0.08	1	.80-.70
Negro							
Farm	19	81	100	21			
Urban	23	77	100	48	0.15	1	.70-.50

TABLE 17.—Location of Churches, by Race and Residence of Respondent

	Per Cent								
	Baton Rouge	Zachary	Open Country	Other Areas	Total	Number	χ^2	df	P
White									
Farm	27	15	11	47	100	72			
Urban	35	6	11	48	100	338	10.83	5*	.10-.05
Negro									
Farm	6	16	39	39	100	31			
Urban	11	9	28	52	100	86	3.64	3	.50-.30

*Degrees of freedom do not correspond to the number of cells in the percentage table. Computation of χ^2 was done with additional cells.

more often in Baton Rouge, but the urban whites do so more often than do the rural whites. The difference is not great, but it is too large to enable one to be certain of homogeneity. The situation is reversed among the Negroes. Their churches are located in the fringe more often, and the tendency is equally evident for both rural and urban members.

For the most part, farmers and urban fringe residents do not share the same recreational patterns (Table 18). Negroes are exceptions—their recreational activities (other than movies) are located in the fringe rather than the city. But for the rest of the population, the nonfarmers spend their more formal leisure in the city to a greater extent than do the farmers.

3. Attitudes and Values

No one has ever seen an attitude or a value. What is seen is the *effects* of these sentiments on behavior, whether that behavior is spoken, written, or acted. This point may perhaps be clarified by distinguishing between opinions and attitudes. An opinion is defined as that sentiment which a person is willing to express before other persons. An attitude (or value) is that which he "really" believes. For purposes of this report, there is no need to distinguish between attitude and value, though in more precise usage, a value is a more deep-seated belief or desire than an atttiude. In other words, both our attitudes and values are tendencies to behave. We may or may not act as we "want" to, depending on the situation.

TABLE 18.—Location of Movies and Other Recreational Forms, by Race and Residence of Respondent

	Per Cent						
	Baton Rouge	Other Areas	Total	Number	χ^2	df	P
MOVIES*							
White							
Farm	67	33	100	46			
Urban	88	12	100	253	13.73	1	<.001
Total							
Farm	66	34	100	56			
Urban	84	16	100	284	9.53	1	<.001
OTHER RECREATION							
White							
Farm	43	57	100	56			
Urban	59	41	100	316	4.94	1	.05-.02
Negro							
Farm	38	62	100	13			
Urban	37	63	100	27	0.00	1	>.95

*Refers only to those attending.

Most of the information contained in this section is based on opinions. Of course, opinions are very sensitive measures of attitudes, but anyone knows that they are far from perfect. For this reason, we want to use opinions as indexes or clues to more basic sentiments (attitudes and values). One must always be willing to supplement the opinions with whatever other types of behavior appear useful in helping to infer the more complete value.

The basic purpose of the questions asked of the respondents, as they are used in this report, is to discover the manner in which the Baton Rouge fringe area was valued. The importance of this sentiment to the present study is crucial. If it can be demonstrated that the rural and urban residents do value the fringe in the same manner, it will mean that the merging of these two population segments has proceeded to a considerable and significant degree.

There was exhibited substantial homogeneity in the answers to the question asked of the interviewees: "Why did your family move to the present residence?" Farm people replied more frequently that they wanted a place of their own, but there were no important differences in the remaining kinds of replies (Table 19). Thus, both farm and urban people moved because they preferred living in the country to the same degree, and both mentioned approximately equally as often that they wanted a larger place or they wanted a better place for their children. Whether these last two replies should have been combined or not (as they are in the table) represents a difficult problem. *A priori*, it seemed most plausible that children would furnish one of the major reasons for wanting a larger place. At any rate, the statistical calculations give no reason to suspect significant differences between these replies.

Most of the answers indicated that the residents held some positive value toward the fringe area. No more than a minority (5 per cent or less) said that they moved to the fringe because they were forced to. On the other hand, most of the fringe inhabitants, with the exception of only one segment, were born at other residences (Table 20). Only Negro farmers had a substantial proportion of "natives," and Negro farmers are decidedly in the minority in the Baton Rouge area. Accordingly, the evidence points strongly to the probability that the opinions expressed by the fringers were in fact part of their other behavior. They moved to the fringe because they wanted to, because in some way it had desirable features.

Respondents who were asked to compare suburban with city living were graded according to a five-point scale: the suburbs rated as better or much better, both city and suburbs rated equally, and the city rated as better or much better. The responses favoring the suburbs were clearly

TABLE 19.—Answers to the Question, "Why Did Your Family Move to the Present Residence?", by Race and Residence of Respondent

	Per Cent						
	Response Given	All Others	Total	Number*	χ^2	df	P
WANTED A PLACE OF THEIR OWN							
White							
Farm	30	70	100	71			
Urban	22	78	100	379	2.82	1	.10-.05
Negro							
Farm	55	45	100	26			
Urban	35	65	100	84	6.65	1	.01-.001
PREFERRED LIVING IN THE COUNTRY							
White							
Farm	20	80	100	71			
Urban	22	78	100	329	0.06	1	.80
Total							
Farm	16	84	100	97			
Urban	19	81	100	463	0.29	1	.70-.50
WANTED A LARGER PLACE OR A BETTER PLACE FOR THE CHILDREN							
White							
Farm	15	85	100	71			
Urban	11	89	100	379	0.21	1	.70-.50
Total							
Farm	10	90	100	97			
Urban	15	85	100	463	1.02	1	.50-.30

*Refers to number of responses rather than number of interviewees. Many interviewees gave more than one response.

TABLE 20.—Mobility of the Fringe Population, by Race and Residence

	Per Cent			Number	
	Born at Place of Residence	Born Elsewhere	Total	Born at Place of Residence	Total
White					
Farm	0	100	100	0	70
Urban	3	97	100	9	336
Negro					
Farm	13	87	100	4	31
Urban	1	99	100	1	87

TABLE 21.—Answers to the Question, "How Would You Compare Living in the Suburbs With Living in the City?", by Race and Residence of Respondent

	Per Cent						
	Prefer Living in Suburbs:						
	"Much Better"	"Better" or Less*	Total	Number	χ^2	df	P
White							
Farm	79	21	100	70			
Urban	69	31	100	335	2.60	1	.20-.10
Negro							
Farm	61	39	100	31			
Urban	52	48	100	87	0.85	1	.80-.70

*Includes in addition, "no preferences," "prefer the city better," and "prefer the city much better."

one-sided. Most respondents rated suburban living as "much better" (Table 21). Only between 4 and 8 per cent rated the city over the suburbs. Further, responses were similar for both farm and urban dwellers.

Farmers and urbanites showed striking agreement in listing the most desirable features of living in the rural-urban fringe (Table 22). For the most part, proportions giving various answers were virtually identical in the two populations. The only divergence from this pattern came in respect to the value of the suburbs for keeping cows and chickens, in having a garden, etc. White farmers volunteered such opportunities as advantages more often than did white nonfarmers. Interestingly enough, there were no important differences in the Negro population with respect to this type of answer. The reason could lie in the possibility that Negroes are more often from a rural background—a condition not uncommon in the South. Perhaps not without importance also, however, is a generally greater emphasis on material advantages by the Negroes, as will be shown in the discussion below.

The frequency of the answers, themselves, is of some interest. Most important were the qualities of privacy, freedom, and quietness. Related, and next in general importance, is the idea of having more space. Concern with people—one's own children and/or one's neighbors—ranked

TABLE 22.—Answers to the Question, "What Do You Consider to Be the Most Desirable Features of Living in the Rural-Urban Fringe (or Suburbs)?", by Race and Residence of Respondent

	Per Cent						
	Response Given	All Others	Total	Number*	χ^2	df	P
HAVE PRIVACY AND FREEDOM, QUIETER, LESS TRAFFIC							
White							
Farm	31	69	100	145	0.00	1	>.95
Urban	31	69	100	702			
Negro							
Farm	18	82	100	59	0.05	1	.90-.80
Urban	18	82	100	146			
MORE SPACIOUS							
White							
Farm	22	78	100	145	0.02	1	.90-.80
Urban	22	78	100	702			
Negro							
Farm	15	85	100	59	0.05	1	.90-.80
Urban	16	84	100	146			
BETTER FOR THE CHILDREN AND BETTER NEIGHBORS							
White							
Farm	17	83	100	145	0.22	1	.70-.50
Urban	18	82	100	702			
Negro							
Farm	7	93	100	59	0.12	1	.80-.70
Urban	8	92	100	146			
AIR IS FRESHER, CLEANER, ETC.							
White							
Farm	10	90	100	145	0.00	1	>.95
Urban	10	90	100	702			
Negro							
Farm	17	83	100	59	0.25	1	.70-.50
Urban	17	83	100	146			
COST OF LIVING IS CHEAPER							
Total							
Farm	3	97	100	204	0.01	1	.95-.90
Urban	3	97	100	848			
Negro							
Farm	7	93	100	59	1.04	1	.50-.30
Urban	12	88	100	146			
CAN HAVE GARDENS, COWS, CHICKENS, ETC.							
White							
Farm	10	90	100	145	6.64	1	.01-.001
Urban	5	95	100	702			
Negro							
Farm	20	80	100	59	0.10	1	.80-.70
Urban	18	82	100	146			

*Refers to number of responses rather than number of interviewees. Many interviewees gave more than one response.

next in the white population, though the importance of "fresh" or "clean" air was more important to Negroes. It is interesting that material traits, such as cost of living and possibility of some farming, generally assumed relatively much greater importance for the Negro population than it did for the whites. Probably an influencing factor in this regard is the low level of living of the Negroes. In their socio-economic condition, it is not surprising that material advantages are of marked importance to them.

Only two persons felt that the fringe had no desirable features. On the other hand, when asked what were the major problems of suburban life, large segments of all the categories could (or would) mention none (Table 23).[12] The problems which were raised fell very readily into either of two categories—transportation on the one hand, or utilities and services on the other (lack of paved streets, fire protection, waste disposal, etc.). Again, there were no important differences between the farm and urban populations in the frequency with which these responses were offered.

TABLE 23.—Answers to the Question, "What Do You Consider to Be the Major Problems of Living in the Rural-Urban Fringe (or Suburbs)?", by Race and Residence of Respondent

	Per Cent							
	Transportation	Utilities and Services	None	Total	Number*	χ^2	df	P
White								
Farm	32	38	30	100	79			
Urban	41	31	28	100	369	2.58	2	.30-.20
Negro								
Farm	27	14	59	100	29			
Urban	31	20	49	100	86	0.91	2	.50-.30

*Refers to number of responses rather than number of interviewees. Many interviewees gave more than one response.

The marked unanimity of the opinions advanced to all of these queries adds more weight to the conclusion offered earlier—that the suburb is a positive and important value to the suburbanites, whether they are farm or urban people. The least that one could say is that both peoples have adopted the same stereotypes of suburban life. Even this conclusion, however, is important to the general hypothesis of the report—that the two groups are becoming similar. The other and stronger possibility is that farm and urban dwellers are adopting the same values toward the place in which they live. The extensive agreement they show favors this last interpretation.

---

[12] For reasons of space, the category of "other" responses was omitted from this calculation. In no case did they constitute as much as one-fifth of all replies. Omitting this category enabled testing for homogeneity with much fewer computations.

III. EXPECTED DIFFERENCES

Whereas in the earlier section the object of investigation was homogeneity, this section represents an examination of heterogeneity, or of differences. Here we expect to find variations, largely because of the differing nature of the occupation which farmers have, including what might be termed their occupational history (apprenticeship, length of time on the job, etc.). There are certain peculiarities of the farmer's job, just as there are of many jobs, which are bound to differentiate his from other jobs, even though in all other aspects of his life he could be indistinguishable from any city man. The same could be said of the policeman, the banker, the milkman, the professor, and so on. In fact, insofar as similarities appear in this sphere, it marks a change in one of the most basic features of rural life—the occupation of farming—and thus lends even stronger support to the central hypothesis of this paper, that of a merging pattern in the ways of life in the rural-urban fringe. But the remarks made above should not be forgotten: as long as there is a distinguishable occupation which can be called farming, there are going to be some patterns of activities which will also be distinct, regardless of what else the farmer may do with his life.

Although the section is broken into two divisions, the separation can only be made abstractly and is here primarily for convenience in presentation. Occupation and employment are quite closely interwoven with ecological mobility, i.e., that movement over the surface of the earth which any organism makes in its adjustment to its environment.

1. Occupation and Employment

The size of the sample permits only a rough division to be made in the occupational classification. For this reason, the terms advanced by Ronald Freedman are used. From a functional point of view, the professionals, managers, officials, clerks, salespersons, domestics, and service workers are classified as "service-production" workers. The remaining categories—craftsmen, operatives, and laborers—are included among the "physical-production" workers. A rough indication of social status is achieved by Freedman by shifting the domestics and service workers from the service-production to the physical-production workers. The new groupings are termed "white-collar" and "blue-collar" workers, respectively.[13] In the present analysis, farmers are classed with the blue collar and with the physical production workers. The differences between the farm and urban populations in respect to these two classifications are marked. Approximately one-fifth of the farmers are in white-collar or in service-production jobs (Table 24). More than one-third of the urban fringe residents are in these categories. Among the wives, most of both categories are, of course, housewives (Table 25). There are no important differences between the farm and urban inhabitants in this respect, with the exception of a

---

[13] Ronald Freedman, *Recent Migration to Chicago* (Chicago, The University of Chicago Press, 1950), pp. 26-27.

TABLE 24.—Occupational Classification of Husband, by Race and Residence

	Per Cent						
	White Collar	Blue Collar	Total	Number	χ^2	df	P
White							
Farm	19	81	100	59			
Urban	35	65	100	284	6.13	1	.02-.01
Total							
Farm	16	84	100	81			
Urban	31	69	100	335	7.54	1	.01-.001
	Service Production	Physical Production					
White							
Farm	20	80	100	59			
Urban	42	58	100	284	9.90	1	.01-.001
Total							
Farm	19	81	100	81			
Urban	37	63	100	335	11.47	1	<.001

TABLE 25.—Housewives and Occupational Classification of Employed Wives, by Race and Residence

	Per Cent						
	House-wives	Other Employed	Total	Number	χ^2	df	P
White							
Farm	86	14	100	64			
Urban	87	13	100	322	0.08	1	.80-.70
Negro							
Farm	75	25	100	24			
Urban	83	17	100	72	2.33	1	.10-.05
	White Collar	Blue Collar					
Total							
Farm	73	27	100	15			
Urban	53	47	100	53	2.01	1	.20-.10

slight heterogeneity in the Negro population. Nor are there important differences in the employed wives, at least as far as the white-collar—blue-collar distinction is concerned. (There were not enough working wives to permit an analysis of the service-production and physical-production classifications.) Most employed wives were white-collar workers. This similarity between rural and urban wives does not seem very important. The employed wives are too few in number to have much effect on the total sample.

Farmers have been employed at their jobs for significantly longer periods than have nonfarmers. As is shown in Table 26, fewer than a third of the farmers had been farmers less than five years, whereas most

TABLE 26.—Length of Employment of Husbands and Wives, by Race and Residence

	Per Cent							
	Under 5 Years	5-14 Years	15 Years and Over	Total	Number	χ^2	df	P
HUSBANDS								
White								
Farm	16	34	50	100	58			
Urban	34	41	25	100	282	16.31	2	<.001
Negro								
Farm	18	23	59	100	22			
Urban	43	39	18	100	51	12.70	2	.01-.001
WIVES								
Farm	29	14	57	100	14			
Urban	62	21	17	100	48	5.10	1*	.05-.02
White	60	21	19	100	47			
Negro	40	13	47	100	15	1.71	1*	.20-.10

*Degrees of freedom do not correspond to the number of cells in the percentage table. Computation of χ^2 was done with combined cells.

had been farmers for 15 or more years. Urban dwellers, on the other hand, usually had been in their occupations for less than fifteen years.

This greater length of service is not surprising. Farming, first, requires extensive contact with the land. It is not an occupation which can be readily changed to suit the needs of the individual. If nothing else, there are seasons to consider. Furthermore, in the case of independent operators, there is the investment in equipment, which acts as a time-binding factor. Most important, farmers are born into their occupations more often than is true of any other type of occupation, at least in the United States.

2. Ecological Mobility

The tendency for farms to stabilize their occupants is clearly illustrated in Tables 27 and 28. (In this connection, see also Table 20.) Farmers had been at the residence in which they were interviewed substantially longer

TABLE 27.—Year in Which the Mobile Population Moved to the Present Residence, by Race and Residence

	Per Cent										
	Before 1940	1940-1945	1945-1950	1951-1952	1953-1954	1955-1957	Total	Number	χ^2	df	P
White											
Farm	27	10	24	13	7	19	100	70			
Urban	12	7	13	9	12	47	100	327	29.35	5	<.001
Negro											
Farm	48	30		22			100	27			
Urban	20	36		44			100	86	8.92	2	.02-.01

TABLE 28.—Number of Moves Made Within the Last Ten Years, by Race and Residence

	Per Cent								
	None	1	2	3 or More	Total	Number	χ^2	df	P
White									
Farm	44	46	6	4	100	70			
Urban	24	56	10	10	100	333	14.22	3	.01-.001
Negro									
Farm	66	30	4	0	100	27			
Urban	37	51	10	2	100	87	7.59	1*	.01-.001

*Degrees of freedom do not correspond to the number of cells in the percentage table. Computation of χ^2 was done with combined cells.

TABLE 29.—Location of Previous Residence, by Race and Residence

	Per Cent								
	Baton Rouge	Suburban Community in Parish	Elsewhere in Parish	Outside of Parish	Total	Number	χ^2	df	P
White									
Farm	34	12	43	11	100	67			
Urban	58	7	21	14	100	313	18.83	3	$<.001$
Total									
Farm	25	15	46	14	100	93			
Urban	49	8	28	15	100	395	21.80	3	$<.001$

than had urbanites, and the number of moves made in the last 10 years was significantly fewer.

The location of the previous residence (Table 29) adds weight to the observation of the stability of farmers. Of course, more nonfarmers came from Baton Rouge than did the farmers, but farmers were more often previously located within the parish.

Approximately one-third of the farmers work at their residence (Table 30). Practically none of the nonfarmers do. But, of those on farms who work elsewhere (Table 31), slightly larger proportions travel greater distances than do the urbanites. In fact, for both farm and urban dwellers, if a person does not work at his residence, he probably will have to commute 10 miles or more. Most of these farmers were not full-time farmers, however. Though they were operating a farm, they also worked elsewhere. It is to these other jobs that they traveled. Persons who made their livings *primarily* by farming usually did so at their residence (see Table 35).[14]

Although the automobile remains the most popular means of transportation to work for all segments of the fringe population, urbanites

---

[14] The reader should remember that the classification of a place of residence as "farm" is not necessarily the same as the classification of an occupation as "farm."

TABLE 30.—Location of Employment for Husbands and Wives, by Race and Residence

	Per Cent							
	At Residence	Baton Rouge	Elsewhere	Total	Number	χ^2	df	P
HUSBANDS								
Total								
Farm	35	43	22	100	82	81.35	2	<.001
Urban	4	80	16	100	335			
Negro								
Farm	53	30	17	100	23	19.52	2	<.001
Urban	7	57	36	100	53			
	Housewife	Elsewhere in Parish						
WIVES								
White								
Farm	86	14		100	63	0.48	1	.50-.30
Urban	89	11		100	327			
Total								
Farm	85	16		100	91	0.82	1	.50-.30
Urban	87	12		100	413			

TABLE 31.—Miles Traveled One Way to Work by the Husband, by Race and Residence

	Per Cent						
	9 Miles or Less	10 Miles or More	Total	Number	χ^2	df	P
White							
Farm	21	79	100	34	4.32	1	.05-.02
Urban	39	61	100	263			
Total							
Farm	23	77	100	44	3.93	1	.05-.02
Urban	38	62	100	305			

TABLE 32.—Method of Husband's Transportation to Work, According To Race and Residence

	Per Cent						
	Car	Other	Total	Number	χ^2	df	P
White							
Farm	75	25	100	40	4.88	1	.05-.02
Urban	88	12	100	278			
Total							
Farm	66	34	100	53	13.02	1	<.001
Urban	86	14	100	324			

prefer it more than do those living on farms (Table 32). Farm dwellers more often use buses, company transportation, or other means.

There is no greater degree of similarity in this set of "expected" differences than exists between the farmers and nonfarmers in the patterns of their hours for departing for and returning from work (Table 33). The agreement is particularly close. Most workers leave after six o'clock in the morning. Approximately one-half return before five in the afternoon.

Two factors are probably responsible for this homogeneity. The first "factor" renders at least part of the similarity more apparent than real. Almost all of the urban workers are employed away from their places of residence, whereas more than a third of the farmers (see above) work "at home." The farmers rise early to farm. The non-farmers rise early to commute.

The second factor, however, cannot be ruled out, at least not with the data at hand. Many of the farmers also work away from their residence—in fact, most do. In these cases, apparently the farmers are adopting the routine hours of the urban population of the Baton Rouge area. This second factor would make plausible the conclusion that merging of the urban and rural patterns has proceeded at least part of the way within one of the most fundamental aspects of urban living—that of the occupation.

IV. THE IMPACT ON FRINGE AGRICULTURE

Not only has urbanization influenced the life of the farmer in general, but it has extended to a large degree to the specific agricultural practices, themselves. This section seeks to discover what the merging has

TABLE 33.—Hour Departing for and Returning from Work, For Husbands, by Race and Residence

	Per Cent						
Departing	Before 6:00 AM	6:00 AM and Later	Total	Number	χ^2	df	P
White							
Farm	25	75	100	36			
Urban	29	71	100	241	0.50	1	.50-.30
Total							
Farm	42	58	100	48			
Urban	21	79	100	285	1.53	1	.30-.20
Returning	Before 5:00 PM	5:00 PM and Later	Total	Number			
White							
Farm	57	43	100	35			
Urban	56	44	100	230	0.04	I	.90-.80
Total							
Farm	59	41	100	46			
Urban	56	44	100	271	0.15	1	.70

done to the fringe farmers and what the effect has been on those who used to farm but have ceased to, either partly or fully.

1. The Farmers

The most obvious impact of the fringe on farming is that it has made the farmer a minority. Negroes and whites have experienced this condition to roughly the same degree (Table 34). The importance of this low proportion rests in its influence on the diffusion of city traits. Being a minority, the farmer is more apt to become urbanized than *vice versa*. But even though the tendency is mainly in one direction, as shall be seen, it is not entirely so.

Almost all persons who operate farms do so at their residence, again whether they are white or colored (Table 35). This last trait, however, is almost the only other feature in which the races are similar.

Size of farms differs markedly between the races (Table 36). Over half of the white population has farms of 100 acres or more (six per cent have more than 1,000 acres), but none of the Negroes has a farm of this size. The large number of small farms should not be ignored, however. Most of the farms of the Negroes are less than 30 acres, as are nearly one-fourth of the farms of whites. It is hardly surprising, therefore, that substantial numbers of the fringe farmers supplement their incomes with off-the-farm work—53 per cent of the white farmers do so, as do 37 per cent of the Negroes.

TABLE 34.—Proportion of Fringe Residents Operating a Farm, by Race of Respondent

	Per Cent						
	Yes	No	Total	Number	χ^2	df	P
White	14	86	100	405			
Negro	16	84	100	118	0.47	1	.50-.30

TABLE 35.—Location of the Farms, by Race of Respondent

	Per Cent			
	At Residence	Elsewhere	Total	Number
White	95	5	100	55
Negro	95	5	100	19

TABLE 36.—Size of Farms, in Acres, by Race of Respondent

	Per Cent							
	3-29	30-99	100 and Over	Total	Number	χ^2	df	P
White	24	23	53	100	53			
Negro	69	31	0	100	19	17.89	2	<.001

Most of the white farmers are engaged in dairying and livestock activities (Table 37), obviously a response to the milk and meat market of metropolitan Baton Rouge. A similar interpretation can be made for the relatively high proportion (almost one-third) engaged in producing poultry, truck vegetables, fruits, and nuts. Negro farmers are found in greatest proportion in the remaining types of farming, especially in cotton and general farming.

2. Nonfarmers

The difficulty of making a rigid distinction between farmers and nonfarmers is sharply illustrated by Table 38. The majority of urban

TABLE 37.—Type of Farming, by Race of Respondent

	Per Cent							
	Dairying and/or Livestock	Poultry, Truck, and/or Fruits and Nuts	Other (Including Cotton, Grain, and General)	Total	Number*	χ^2	df	P
White	46	31	23	100	71			
Negro	10	38	52	100	21	10.93	2	.01-.001

*Since farmers engage in more than one type of farming, there are more types of farming than there are farms.

TABLE 38.—Farm Items Possessed by Nonfarm Families, by Race of Respondent

	Per Cent						
	Some	None	Total	Number	χ^2	df	P
White	77	23	100	580			
Negro	88	12	100	191	11.43	1	<.001
	Gardens	Other					
White	41	59	100	444			
Negro	36	64	100	168	1.11	1	.30-.20
	Chickens	Other					
White	22	78	100	444			
Negro	38	62	100	168	15.09	1	<.001
	Cows	Other					
White	21	79	100	444			
Negro	11	89	100	168	8.63	1	.01-.001
	Hogs	Other					
White	4	96	100	444			
Negro	14	86	100	168	18.69	1	<.001
	Total*	Other					
White	89	11	100	444			
Negro	99	1	100	168	....	..	..

*Totals do not sum to the one listed since the parts were separately rounded.

dwellers, of both races, in the fringe possess some farm items, although Negroes have relatively more items than do whites. Gardens are equally popular among members of both races. Negroes, however, keep chickens and hogs more frequently than do whites, whereas the white residents more often have cattle.

This preponderance of farm items among the fringe's urban people represents a real diffusion. Few of the nonfarmers have ever operated a farm, in the full sense of the term (Table 39). The significance of this fact is to be found in association with the number of farm items these people possess. The people are more correctly described as urbanites who have to some extent become farmers—not ex-farmers who are retaining some of their old practices. Therefore, as intimated earlier in this report, the merging of the rural and urban components of the fringe has proceeded in both directions, in spite of the much heavier city influence.

Perhaps the most dramatic impact on fringe agriculture is that on those farmers who have given up their farms. Almost one-fifth of the sample falls in this category (109 respondents). Most Negroes gave up their farms and moved elsewhere, though still within the Baton Rouge fringe (Table 40). Most whites stayed on at least some portion of their land. Very few of these ex-farmers, therefore, are from outside of the parish. The pattern apparently has been to give up the farm and take a job in the nearby city.

The reasons given by the respondents for changing their occupations have been almost exclusively either economic or for the closely related reasons of health, a family death, or old age. Nine-tenths of all replies fell in either of these two categories. In greater detail, the whites listed the following reasons as being the most important factors in giving up their farms: because the farm did not produce enough income (39 per cent), because they had secured a better job elsewhere (12 per cent), for reasons of health (12 per cent), and because of old age (9 per cent). Negroes,

TABLE 39.—Nonfarm Families That Have Ever Operated a Farm, by Race of Respondent

	Per Cent						
	Yes	No	Total	Number	χ^2	df	P
White	20	80	100	348			
Negro	38	62	100	100	14.56	1	<.001

TABLE 40.—Location of Previous Farms for Nonfarm Families, by Race of Respondent

	Per Cent							
		Elsewhere						
	At Place of Interview	In Parish	In This or Other State	Total	Number	χ^2	df	P
White	46	24	30	100	70			
Negro	36	54	10	100	39	11.06	2	.01-.001

on the other hand, listed health as the major reason (35 per cent), followed by their low farm income (26 per cent), a family death (12 per cent), and because they felt that they "couldn't continue two jobs, so they gave up farming" (9 per cent). Speaking more generally, the white farmers gave up farming mainly for economic reasons. Negroes were fairly evenly divided between reasons of health and economic ones. (These combined categories are shown in Table 41.)

TABLE 41.—Reasons Offered for Giving Up Farming, by Race of Respondent

	Per Cent						
	Economic	Health, Death, or Old Age	Total	Number	χ^2	df	P
White	71	29	100	68			
Negro	44	56	100	39	7.59	1	.01-.001

3. The Impact in General

The impact of the merging tendency on the agriculture in the fringe has been marked and rather drastic. In the first place, many farmers have simply given up. Whether the resulting change of jobs has been caused by, influenced by, or merely associated with the expanding metropolis is a point which will probably never be decided. It is the writer's opinion, however, that the expanding city has played a major role, if not the major one, in this change.

Another quite important accompaniment has been the emphasis placed by the farmers on the Baton Rouge market. This is an obvious point. Nevertheless, it should not be overlooked.

The more significant meaning of this impact is to be found in the pervasiveness of the urbanizing influence. It has taken some farmers out of agriculture. It has divided the allegiance of others, making them part-time farmers to some degree. And it has affected the market of those farmers who have elected to retain that vocation.

V. SUMMARY AND CONCLUSIONS

1. Assessment of the Rural-Urban Differences

A close study of the various differences between the rural and urban populations of the Baton Rouge fringe brings one to the unavoidable conclusion that a merging of these segments has proceeded to a striking degree. Even a brief glance at Table 42, where the statistics of this bulletin are summarized, is enough to impress one with the extent of the merger. Adding all of those traits which could have occurred by chance more frequently than 10 per cent of the time and contrasting them with those which would occur 10 per cent or less, one discovers that in more than one-half of the cases, merging has occurred. There is an even greater degree of merging in that section where there was reason to expect that

TABLE 42.—Summary of the Degrees of Homogeneity Between the Farm and Urban Segments of the Fringe Population

Table Number		Highest Probability of the Given Difference Occurring by Chance		
		White	Negro	Total
	MERGING TRAITS			
2	Married Population			
	A. Male		. .	.02
	B. Female	.70	. .	.10
3	Divorced Population		. .	.70
4	Family Composition	.001	.20	
5	Number of Children		. .	.05
6	Age			
	A. Husbands	.001	.01	. .
	B. Wives	.01	.05	. .
7	Schooling Completed			
	A. Husbands	.50	.10	
	B. Wives	.50	.80	
8	Income	.10	.80	
9	Home Tenure	.001	.05	. .
10	Location of Places of Purchase For:			
	A. Food	.50	.30	
	B. Clothing	.20	.80	
	C. Medicine	.01	.70	. .
11	Location of Places of Purchase For:			
	A. Furniture	.95	. .	.70
	B. Appliances	.50	.50	. .
	C. Automobile Services	.20	.30	. .
12	Location for Obtaining:			
	A. Insurance	.02	.20	. .
	B. Banking	.02	. .	.05
13	Location for Obtaining:			
	A. Medical Services	.10	.50	. .
	B. Dental Services	.20	.50	. .
14	Number of Civic and Social Organizations			
	A. Husbands	>.95	.10	. .
	B. Wives	.50	>.95	. .
	C. Children	.30	. .	.80
15	Location of Civic and Social Organizations			
	A. Husbands	. .	. .	.20
	B. Wives	. .	. .	.70
	C. Children	. .	. .	.70
16	Location of Children's Schools	.80	.70	. .
17	Location of Churches	.10	.50	. .
18	Location of Recreation			
	A. Movies	.001	. .	.001
	B. Other Forms	.05	>.95	. .
19	Reasons for Moving to the Present Residence			
	A. Wanted a Place of Their Own	.10	.01	. .
	B. Preferred Living in the Country	.80	. .	.70
	C. Wanted Larger Place or Better Place for Children	.70	. .	.50
21	Comparison of Suburban with City Living	.20	.80	. .

(Continued)

TABLE 42.—(CONTINUED)

Table Number		Highest Probability of the Given Difference Occurring by Chance		
		White	Negro	Total
	MERGING TRAITS (continued)			
22	Desirable Features of Fringe			
	A. More Privacy	>.95	.90	. .
	B. More Spacious	.90	.90	. .
	C. Personal Relations	.70	.80	. .
	D. Air	>.95	.70	. .
	E. Cost of Living	>.95	.70	. .
	F. Rural Living	.01	.80	. .
23	Problems of the Fringe	.30	.50	. .
Total Merging Traits				
	Over .10	22	23	8
	.10 and less	14	6	5
	EXPECTED DIFFERENCES			
24	Occupational Classification of Husband			
	A. White collar-blue collar	.02	. .	.01
	B. Service production-physical production	.01	. .	.001
25	Occupational Classification of Wives			
	A. Housewives	.80	.10	. .
	B. White collar-blue collar	.	. .	.20
26	Length of Employment			
	A. Husbands	.001	.01	
	B. Wives	. .	. .	.05
27	Year of Moving to Present Residence	.001	.02	. .
28	Number of Moves	.01	.01	. .
29	Location of Previous Residence	.001	. .	.001
30	Location of Employment			
	A. Husbands	.	.001	.001
	B. Wives	.50	. .	.50
31	Miles Traveled to Work	.05	. .	.05
32	Hour Departing and Returning from Work			
	A. Departing	.50	. .	.30
	B. Returning	.90	. .	.70
33	Method of Transportation	.05	. .	.001
Total Expected Differences				
	Over .10	4	0	4
	.10 and less	8	5	7
Total All Traits				
	Over .10	26	23	12
	.10 and less	22	11	12

merging *could* occur. Approximately two-thirds of these traits were homogeneous, as contrasted with less than one-third of the traits which were "expected" to be different (primarily, it will be remembered, because of the different nature of the type of job involved).

The importance of *any* degree of merging, let alone the merging of a majority of traits, is to be emphasized. One could normally expect differences to appear in all of the traits enumerated. A reading of any text on rural sociology would be convincing enough on this point. But what has happened is that the farmers are no different from the urban people in respect to most of the behavior patterns, institutions, and values studied.

It is not merely the number of traits which is important in the merging process. The tendency toward homogeneity has proceeded even to certain critical areas. Difficult to evaluate statistically, yet probably more important than most traits studied, is the fact that many farmers in the fringe area have given up farming, and even those who have not done so have adjusted their occupational lives noticeably to urban patterns. Urbanization, therefore, has struck to one of the very reasons for the existence of rural life—farming itself.

Other important facets of rural living have also been influenced. The opinions of the fringe residents, whether urban or rural, are seen to be identical in many respects, and they are similar in practically all areas. There is no exaggeration in saying that farmers and city folk in the Baton Rouge fringe area hold many of the same sentiments—and perhaps they hold most of them in common. Other segments of life which show particularly close similarities are in the realm of education and in activities connected with shopping and with belonging to civic and social organizations.

In spite of the impact of merging, there are some notable resistances. First, the farmer is still a farmer. His occupational activities—as important as any to his life—are markedly different from those of his urban neighbors. That some change even here has taken place has been granted. Nevertheless, farmers are still a distinguishable lot.

They are distinguishable in another manner—in their family life. Farmers have larger families and more children. They also own their own homes more often and are older. The fact that these differences are traditional is of even greater importance. It indicates more strongly that such differences are not accidental—they remain as one of the last vestiges from the rather sharp distinctions which once prevailed between city and country. One more factor needs to be indicated: this set of differences is one of the only *systematic* sets of differences encountered in this study (the only other one was in the farmer's occupation). And none of these differences was without occasional patches of similarity.

Mention has repeatedly been made of the *direction* of the merger: from urban to rural rather than *vice versa*. It is not possible to depict the degree or amount of this direction as accurately as it was possible to show the degree of merging. In other words, it can be said that merging has taken place in more than half of the traits studied. Or it can be said that such and such a trait departs from chance frequencies to such and such a degree of probability. The measures concerning the merging are thus quantitative and possess at least some precision. But to show the strength of the urban influence over the rural influence is another matter. It can be done, as will be apparent presently, but it can be done only qualitatively in this study. The reasons for the difficulty are two-fold. First, the study lacks extensive historical data. Such is most often the case in analyses which must rely on *ad hoc* data, i.e., information gathered specifically for one given purpose, as is true of the present study. Second, there is no precise cutting point to any measure which will mark off the difference between urban and rural. These distinctions are gradual. One can see differences clearly only when viewing extremes. The New Orleans metropolitan resident will differ from the Mississippi Delta sharecropper in clear and obvious terms. But when one is viewing the middle of the continuum between these two extremes, differences are not always readily visible. Such a statement should only be too clear to the readers who have progressed this far in the present bulletin.

In spite of the difficulties, the fact of urban dominance over the fringe residents is clear and unmistakable. Baton Rouge figures generally as the most popular location for the various activities, other than the respondents' own homes. Farmers are leaving for the city vastly more than city dwellers are becoming farmers, at least in the Baton Rouge fringe. The influence on the farmer's occupation has only recently been noted (in the preceding section). The number of children, though large, is smaller than one would expect in more completely rural settings. And, finally, the income and educational levels, both of which are essentially urban in their development and influence, are too high in comparison with traditional rural levels for one to argue that the city people are the ones who are changing.[15] Some change has occurred among the urban residents of the fringe. This change, in the form of gardening, etc. has been noted, and is in a rural direction. But the entries on the other side of the ledger are much too great to permit one to talk of a balance.[16]

As a final assessment, one would conclude that the farm and urban components of the fringe are merging, that they are merging towards the urban type of life and have done so to a considerable degree, but that the process is not complete. The conclusion, however, can go further. Whether or not there is only one homogeneous population, the fringe residents are apt to be remarkably alike. In this area, the old distinction between rural and urban worlds has broken down. Some vestiges do remain. But whoever deals with the people of the fringe, and especially with the farmers, had best be cautious of approaching them with the traditional picture of separate and distinctive rurality in mind.

---

[15] Cf. the various differentials noted in T. Lynn Smith and Homer L. Hitt, *The People of Louisiana* (Baton Rouge: Louisiana State University Press, 1952), and Paul H. Price, *Louisiana's Rural Population at Mid-Century* (Baton Rouge: Louisiana Agricultural Experiment Station, Bulletin No. 514, June 1958).

[16] The conclusion reached in this study differs somewhat from that of Stuart A. Queen and David B. Carpenter in their "[The Rural-Urban Fringe] from the Urban Point of View," *Rural Sociology*, Vol. 18 (June 1953), pp. 101-108. These authors maintained that the residents of the fringe more closely *resembled* the rural than the urban inhabitants. Several points should be kept in mind, however, in comparing the present study with that of Queen and Carpenter. (1) Each study is limited to a small sample—one metropolitan area for the present study and seven for Queen and Carpenter's. (2) Seven years separate the two studies. Though this factor may not have much bearing on the differences, one should remember that the nation is urbanizing at a very rapid rate. (3) Queen and Carpenter assumed that the rural-farm areas in the states in which their metropolitan areas were located were in fact as extremely rural as one could get (i.e., in their urbanization index, these rural-farm areas were given the value of zero). One could argue that the rural-farmers were already urbanized to a large degree, even in 1950 (the date for the data of the study). From this viewpoint, the fact that three-fourths of their measures showed the fringe dwellers to be more than 40 per cent of the distance between the urban and rural populations (closer to the rural) is itself of significance. (4) Finally, Queen and Carpenter were speaking of resemblance, whereas this study has attempted to cope also with the more elusive problem of dominance. Related is the greater use of qualitative analysis in the present report than in Queen and Carpenter's. When one bears in mind all of these points, the differences between our study and Queen and Carpenter's study are not as contradictory as they appear at first glance, if, indeed, they are to be judged as contradictory at all.

2. Implications

There are at least two types of implications to be found in this bulletin. The first to be considered are those which are pertinent to Louisiana's rural life. The second concerns the implications which may be extended to the nation and to urban life in general.

In order to fully appreciate the implications which the study has for the rural population of Louisiana, it must be realized that the state is not a homogeneous mass. Its people differ, and its rural people are no exception. Perhaps the information presented here can be more readily interpreted if the study is regarded as based on several kinds of samples, all built into the one sample which was actually drawn:

1. The study is a sample of the Baton Rouge fringe. The relation here is closer than any other—so close, in fact, that it has been mathematically described. The probability analysis used throughout the study has provided this description.

2. The study is a sample of the fringes of the state's cities, including its three standard metropolitan areas—Baton Rouge, New Orleans, and Shreveport. The relation of Baton Rouge to these other areas cannot be mathematically described, but the quality of the relationship still can be indicated. The peculiar importance of Baton Rouge has been noted in the introduction to this bulletin. The city is in many respects quite representative of Louisiana's cities. Particularly, it should be noted that (1) although larger than many, it is not extreme in size, and (2) it lies between the fundamental divisions of French and Anglo-Saxon Louisiana.

3. The study is a sample of the state's rural population, in general. This last relation, especially that to the farm population, is the weaker of the three relationships noted. But the relation can be called weak only by comparison. The farmers in Baton Rouge are, after all, Louisiana farmers.

Two of the major differences between farmers residing in the fringes of the state's major cities and the remaining farmers are to be found in the different proximity to urban areas and in differences in the type of farming and socio-cultural life.

One may be tempted to assume that the influence of the city would be closely related to the distance which farmers live from the city. If mechanization be taken as an index of urbanization, one finds that in reality there are other complicating factors. Some of the information collected for a study of agricultural mechanization showed that, although proximity to major urban centers was an important correlate of farm mechanization, the type of life lived in the area was in some cases more significant. The sugar cane area, for example, has probably been more heavily mechanized than any other rural area in the state, whereas the cut-over areas of North Central and West Central Louisiana as well as the North Louisiana Uplands area have been affected least.[17]

Mechanization is, of course, only one facet of urbanization, and this facet has received no more than a brief mention here. Nevertheless, the remarks should indicate that, in attempting to assess the influence of urbanization on the other areas in the state, allowance should be made both for distance from urban centers and for the type of rural life which has developed in the area under question. The more rural sections of the state, particularly those with lower socio-economic levels of living, should be farther removed from the conditions described in the Baton Rouge area.

In brief, therefore, the findings of this study do not necessarily show what is happening now in all of the rest of rural Louisiana. Some areas will approach the picture rather closely. For other areas, the findings should probably be regarded as examples of what can occur in the years to come, especially if the cities of the state continue to grow and develop.

When seeking to generalize this study to other areas of the nation, one of the more important facts to be kept in view is the rurality of the state. Though over half of the population was living in cities (54.8 per cent) in 1950, over one-third (36.0 per cent) was on farms, a proportion more than twice as large as that in the nation as a whole (16.6 per cent). What has happened in Baton Rouge is thus a type of preview of what can be expected in many of the more rural areas of the country as urbanization proceeds.

Of course, Louisiana's heavy rurality also means that it necessarily has lagged behind the nation in the urbanization trend. Certainly, it is not representative of what *has* occurred in the nation's "urban region" in the Northeast and in related areas. These portions of the country developed to a large extent as automotive transportation developed. Baton Rouge saw its major development *after* the automobile was pretty much an accomplished fact. We can thus say that Baton Rouge is more a taste of things to come than it is of things past. How representative it will be is a finding which must depend on time and other studies.

In larger perspective, however, Baton Rouge is but one of more than 150 metropolitan areas in the United States. All of these have developed extensive fringe areas, most if not all of which also contain farmers. Insofar as the Baton Rouge experience is not peculiar in respect to the development of urban fringes generally (and there is no reason to think so), it mirrors a fundamental change which is occurring in the nation's cities. They are integrating more diverse groups in larger populations over larger areas—more so than ever before. This much of the change is a quantitative difference, a difference which, on the surface, is only more of what has been in the past. However, in this expansion, if Baton Rouge can be any guide, the cities are encompassing what at one time was the very opposite of urban life—the farm people. And they are incorporating these people not as migrants but as farmers. In these ways, and especially in the last way, cities are new.

---

[17] Alvin L. Bertrand, *Agricultural Mechanization and Social Change in Rural Louisiana* (Baton Rouge: Louisiana Agricultural Experiment Station, Bulletin No. 458 June 1951), p. 10, esp. Fig. 1. For the location of Louisiana's rural areas, see Bertrand, *The Many Louisianas, op. cit.*, Fig. 1.

Not to be overlooked is another feature, that of the dominance of urbanization. The city is engulfing the farm, rather than *vice versa.* None can say whether the city will ever dominate all farmers. But it has done so for some—for those in the Baton Rouge area and most likely for numerous others in fringe areas across the country.

TECHNICAL APPENDIX

1. Theory and Concepts

Formation of Hypotheses.—The study is primarily designed to test the first of the two major hypotheses offered: that the city is undergoing a fundamental change. The second major hypothesis shows part of the nature of this change: that the rural areas are being incorporated in this process. The first specific hypothesis describes the extent to which the change has occurred: it has developed to the extent that the fringe is homogeneous. The second shows the direction of this change: it emanates from the city.[1]

These major and specific hypotheses are part of the present writer's attempts to realize one of the problems which Professor Price was attempting to solve. Informally, Price had stated that he believed the rural-urban fringe to be a fundamentally new kind of thing. In this thesis his co-author has concurred. He has only linked the newness to something else.

---

[1] Other researchers have noted the increasing change in both rural and urban areas and have argued on this basis for a change in concepts. See Alvin L. Bertrand, "Rural Locality Groups: Changing Patterns, Change Factors, and Implications," *Rural Sociology,* Vol. 19 (June 1954), pp. 174-179; E. Gordon Ericksen, "The Superhighway and City Planning: Some Ecological Considerations with Reference to Los Angeles," *Social Forces,* Vol. 28 (May 1950), pp. 429-434; Noel P. Gist, "Ecological Decentralization and Rural-Urban Relationships," *Rural Sociology,* Vol. 17 (December 1952), pp. 328-335; C. Horace Hamilton, "The Sociology of a Changing Agriculture," *Social Forces,* Vol. 37 (October 1958), pp. 1-7; Stuart A. Rice, "Problems in the Statistics of Urban Agglomeration," *Science* (November 7, 1958); C. R. Wasson, "Does Increasing Urbanization of the Rural Areas Require a Re-examination of Some of Our Basic Postulates?" *Rural Sociology,* Vol. 4 (March 1939), pp. 88-89; Nathan L. Whetten, "Suburbanization as a Field for Sociological Research," *Rural Sociology,* Vol. 16 (December 1951), pp. 319-330.

All of the hypotheses mentioned above were formulated before the data which had been collected were processed. The later author had seen the schedules and knew the "problem" as Price had conceived it. But as to what was to be found, this was as yet an unexplored region.

It was in examining other studies of the fringe that the importance of what had been taking place began to be evident. The writer believed that in view of the changes which were being described by other authors for both rural and urban areas, a change of a quite basic nature had been taking place in the cities.

Accordingly, the present rural-urban distinction would then be a "fiction," to use the term of Ernst Borinski, at least for most of the United States and especially for the area under study. There are undoubtedly some places, residual areas where historical trends have not as yet affected the nature of the differing social organizations, where legitimate distinctions yet prevail between rural and urban areas. Both of the major hypotheses, and the second one specifically, contend that there is no such legitimate (i.e., "legitimate" in the scientific sense) distinction in many parts of the U. S. in general, and in the area under study in particular. The rural-urban distinction was thus once a reality but persists now only in a manner similar to legal fictions.

As the data were being processed, one point became obvious which should have been obvious from the beginning (which is usually true of the things which are labeled "obvious"). Some differences were emerging which were due not to any resistance to the merging pattern but to the fact that the farmer had a different kind of job. Occupational differences are, of course, part of the fabric of urban living.

The descriptive theory which seemed most adequate to help in explaining these differences was Toennies' concepts of *Gemeinschaft-Gesellschaft*. According to the hypotheses of the study, one would expect the rural area in the fringe to become more *Gesellschaftlich*. As far as differences were concerned, one could generally not expect to find any, at least between the rural-urban segments. Some traits, however, should be different, specifically those traits which pertained to the kind of job the farmer had. He rose early, stayed at his job through many years, worked at his residence, etc., not so much because farming is *Gemeinschaft,* but because these things develop through the division of labor which separates farming from other jobs. In other words, in this area of what has been called "expected differences," the job traits and those associated with them are different because of their part in a larger *Gesellschaft* picture. Remember, these expectations are raised because of the implications of the hypothesis, that the rural area (and the fringe as a whole) is becoming more *Gesellschaftlich.*

The problem of investigating the differences between the farm and nonfarm populations therefore split itself into two major areas: those traits which could merge and those which one would expect to find different, even if the entire fringe was "uniformly" *Gesellschaft.*

Method.—A problem of somewhat lesser theoretical importance arose in connection with organizing the numerous traits for which information had been gathered. The frame of reference which Price had adopted in constructing his questionnaire was unknown. A fairly adequate approach did present itself, however, in the form of a two-fold set of screening criteria. Insofar as possible, traits were selected from each of the major institutions (family, education, economics, government, religion) and from each of Homans' four categories of group elements (activities, interaction, sentiment, and norms). Of course, this goal could only be approximated, since the criteria were chosen after the schedules had been taken. In particular, no information was gathered on government, little on religion, and the distinction between activities and interaction is practically nonexistent. Nevertheless, the institutional and the Homans points of view did enable the writer to discuss an extremely broad range of topics. It is believed that a relatively systematic enumeration of the more important traits in the fringe area has been attained.

The Terms "Fringe" and "Suburban."—In this study, the terms "fringe" and "suburban" are synonymous. In the case of Baton Rouge, they refer to that part of East Baton Rouge Parish which, in 1957, lay outside of the corporate limits of the city of Baton Rouge. This usage is not meant to deny the importance of numerous efforts to describe in greater detail the many parts of the rural-urban fringe.[2] Rather, it was taken because the size of the sample as well as the method of sampling (see the "Introduction") did not permit a useful breakdown of the fringe on a territorial basis. Undoubtedly, the hypotheses would have attained greater precision if they had distinguished between suburb and fringe, limited and extended fringe, etc. It is important to note, however, that in spite of the lack of such refinements, the hypotheses were still generally substantiated.

2. Statistical Considerations

The Use of the .10 Level of Significance.—In this report, the 10 per cent level of significance has been adopted as the limit for the acceptance or rejection of the null hypothesis (H_0) instead of the usual 5 or even 1 per cent. The reason for this choice rests in the different nature of the statistical hypotheses to be tested. The object of this study is to *confirm or accept* H_0 rather than to reject it. In such instances, one would want to be especially cautious in committing errors of the second kind, i.e., he would want to avoid accepting H_0 when H_0 is actually wrong (as contrasted with the first kind of error: rejecting H_0 when it is true). Consequently, it becomes desirable to omit from consideration any item which gets even close to the tail of the chance distribution. Normal scientific procedure is still being followed, even if it is used in a manner not too often encountered: the choice of the 10 per cent level forces the researcher to lean over backwards toward not proving what he wishes to prove.[3]

---

[2] See for example, Richard A. Kurtz and Joanne B. Eicher, "Fringe and Suburb: A Confusion of Concepts," *Social Forces,* Vol. 37, No. 1 (Oct. 1958), pp. 32-37; Walter C. McKain, Jr. and Robert G. Burnight, "[The Rural-Urban Fringe] From the Rural Point of View," *Rural Sociology,* Vol. 18, No. 2 (June 1953), pp. 108-117; Samuel W. Blizzard, "Discussion," *ibid.,* pp. 118-119.

The specific choice of 10 per cent is, of course, as arbitrary as any other choice. It was dictated as much in reference to statistical convention as anything else. One is here faced with the question, how similar do statistics have to be before we can label them as occurring in a homogeneous sample? The claim made in this report is that an observed difference between rural and urban samples which may occur more frequently than 10 per cent of the time is in fact due to chance variations, and the two population groups are alike rather than different. However, if an observed difference between the two groups may occur less frequently than 10 per cent of the time by chance, we conclude that non-chance factors produced the differences, i.e., the differences are "real."

Whether a lower level of significance would have been preferable is difficult to say. If, for example, the level of significance had been reduced to 20 per cent, this choice would have meant that chance factors would have *probably* been discarded more often and that real differences would have been assumed to exist when they might not have been present. In other words, the chance of making an error of the first kind (rejecting H_0 when H_0 should not be rejected) would have been increased. Eventually, of course, all of the differences would have been assumed to have been real, and the application of probability statistics here (or anywhere else) would have been impossible. Parenthetically, one should note that even shifting the significance level to 20 per cent would have only changed six traits for the white and Negro populations from the category of chance differences to that of real differences (see Table 42).

The choice of the 10 per cent level, then, can be "justified" only in reference to usual statistical customs. In attempting to establish *differences,* one is sure of the existence of differences only when chance could *rarely* influence the measurement. When one is interested in establishing *similarity,* chance differences are assumed to play a larger role in the observation. In this paper, an arbitrary level has been accepted, one somewhat lower than normal because the peculiar problem called for a lower level of significance. Just how low the level should be is a question which has not yet been determined.

---

[3] Cf. Margaret Jarman Hagood and Daniel O. Price, *Statistics for Sociologists* (New York: Henry Holt and Co., 1952), revised ed., pp. 323 ff.

The Use of Chi Square.—Chi square was chosen as the principal measure of homogeneity because most of the variables were dichotomous or qualitative—farm, urban; white, Negro; location of shopping center; attitudes; marital status; etc. In fact, the principal differential was always dichotomous—i.e., farm-nonfarm. This measure is therefore the one which is most applicable to the majority of the statistics utilized (see Table 42). In other conditions, as where continuous variables are artificially dichotomized, the applicability of the measure is lessened. Conclusions attempted in such cases were accordingly guarded. Limitations of resources prevented more extensive applications of statistical tests. This qualification means that the present study should not be accepted as conclusive in every respect. However, it is the opinion of the present writer, borne out by some empirical testing, that more refined analysis would not alter the conclusions of this study in any significant manner.

One additional point should be made, not specifically about chi square but about the chi square tables. It will be noted that at times slight differences appear in the frequency of the same trait when it appears in separate tables. Thus, 70 white farm husbands are shown in Table 7, whereas only 69 appear in Table 6. Such differences stem from the fact that "no answer" and "does not apply" categories have been omitted from the tables, since they are inapplicable to the computations of statistical significance.

Percentages.—No decimals are shown for percentages, for two reasons. First, in many cases, the base numbers (i.e., the "whole") for the calculation of percentages were less than 100, and in such cases, decimals are quite meaningless. A unit change in the raw number for which the percentage is calculated is always more than 1 per cent, and thus the calculation of fractional percentages implies a degree of minuteness which does not exist. Second, all statistics are sample statistics and are thus subject to sampling error—even where the base is three or four or five hundred responses. The probable error within which the parameters lie in such cases is usually more than 1 per cent at the 5 per cent level of probability.

Qualifications of the Sample.—An area sampling technique, such as has been employed in this bulletin, is peculiarly subject to biases which result when certain population characteristics show any pronounced tendency to distribute themselves in territorial clusters, i.e., in selected parts of the area being sampled rather than in others. There is reason to suspect that such a bias may possibly have been at work in the sample with respect to the Negro population. Reasons for the suspicion are to be found, first, in the presence of some residential segregation in the fringe area (although the precise amount is undetermined) and, second, in the discrepancy between the sample (taken in 1957) and the composition of the fringe area according to the 1950 census. At the earlier date, nonwhites composed 39.7 per cent of the fringe population as it was defined in this study.[4] The sample gives only 22 per cent Negroes. The difference between the earlier parameter and the later sample is significant much beyond the .001 level.

The variation between the two proportions could, of course, be due to a shift of the Negro population from the suburbs to the city of Baton Rouge proper. The shift could be actual, relative (i.e., due to differential growth), or both. Whether a shift has in fact occurred or whether there has developed a real discrepancy because of sampling bias will have to await an analysis of the 1960 census. (The special census taken in 1958 was for the city of Baton Rouge only.) Because it was unknown whether this discrepancy was real or due to sample bias, no generalizations are intended for the population as a whole. Generalizations are limited to the white and nonwhite populations, respectively. Where the total population had to be used, it was employed in order to infer something about the segments of the population.

On the other hand, the proportions of farm and "urban" (nonfarm) populations are apparently representative. There has been a shift away from farmers (they declined from 22.3 per cent in 1950 to 19 per cent in the 1957 sample), but this shift is not too far from the original base and is, furthermore, in the direction expected. Not only is it in harmony with national trends, but it is in harmony with the increasing growth of the city itself (from 125,629 persons in 1950 to 150,879 in 1958). And the reader should bear in mind that the basic problem before this study is that of farm-urban differentials.

---

[4] Scotlandville, with an estimated 1950 population of 7,000 people, was excluded from the sample area. This area is almost exclusively Negro in racial composition. Presumably, Professor Price excluded Scotlandville since it is practically completely urban in population, coterminous with Baton Rouge, even though unincorporated.

S67
E5b

BULLETIN No. 527 OCTOBER 1959

Statistics on Livestock and Livestock Products, by Parishes in Louisiana Selected Years, 1910-1954

Stephn

BY

J. P. MONTGOMERY

NEW MEXICO STATE UNIVERSITY
SEP 1 1964
LIBRARY

SURPLUS
TO REQUIREMENTS AS
Superseded
Worn Out
Obsolete
Unbindable
Duplicated
NMSU LIBRARY
LAS CRUCES

LOUISIANA STATE UNIVERSITY
AND
AGRICULTURAL AND MECHANICAL COLLEGE
AGRICULTURAL EXPERIMENT STATION
CHARLES W. UPP, *Director*

CONTENTS

Page
Introduction . . . 4
The value in dollars of agricultural products sold by farms, by parishes, 1940-1954, Table 1 . . . 5
The value in dollars of all livestock on farms, by parishes, 1910-1954, Table 2 . . . 7
Number of farms and livestock sold, by parishes, 1940-1954, Table 3 . . . 10
The value in dollars of all cattle and calves on farms, by parishes, 1910-1954, Table 4 . . . 13
Number of farms reporting cattle, by parishes, 1910-1954, Table 5 . . . 16
Number of cattle and calves on farms, by parishes, 1910-1954, Table 6 . . . 19
Number of farms reporting cows, including heifers two years and over, 1930-1954, Table 7 . . . 22
Number of cows on farms, including heifers that have calved, by parishes, 1910-1954, Table 8 . . . 24
Number of farms reporting milk cows, by parishes, 1930-1954, Table 9 . . . 27
Number of milk cows on farms reporting milk production, by parishes, 1910-1954, Table 10 . . . 29
Number of farms and of cattle, by parishes, 1954, Table 11 . . . 32
Number of cattle and/or calves sold alive, by parishes, 1940-1954, Table 12 . . . 34
The value in dollars of dairy products sold, by parishes, 1910-1954, Table 13 . . . 36
The value in dollars of whole milk sold, by parishes, 1930, 1950, and 1954, Table 14 . . . 39
The value in dollars of hogs, by parishes, 1910-1950, Table 15 . . . 41
Number of farms reporting hogs (of all ages) on farms, by parishes, 1930-1954, Table 16 . . . 44
Number of hogs and pigs on farms, by parishes, 1910-1954, Table 17 . . . 46
Number of hogs on farms, by parishes, 1910-1954, Table 18 . . . 49
Number of hogs four months old and over, by parishes, 1930-1954, Table 19 . . . 52
Number of hogs less than four months old, by parishes, 1930, 1950, and 1954, Table 20 . . . 54
The value in dollars of all sheep and lambs, by parishes, 1910-1950, Table 21 . . . 56

CONTENTS

Page
Number of farms reporting sheep and/or lambs on farms, by parishes, 1930-1954, Table 22 58
Number of sheep and lambs on farms, by parishes, 1910-1954, Table 23 60
Number of ewes one year old and over, by parishes, 1920-1954, Table 24 63
Number of lambs under one year of age, on farms, by parishes, 1910-1954, Table 25 65
Number of rams and wethers on farms, by parishes, 1930, 1950, and 1954, Table 26 67
The value in dollars of wool shorn, by parishes, 1910, 1920, 1930, and 1950, Table 27 69
Number of farms reporting sheep and lambs shorn, by parishes, 1930-1954, Table 28 71
Number of sheep and lambs shorn, by parishes, 1910-1954, Table 29 73
Number of pounds of wool shorn, by parishes, 1910-1954, Table 30 75
Number of farms reporting horses and/or mules, by parishes, 1930-1954, Table 31 78
Number of horses and colts on farms, by parishes, 1910-1954, Table 32 80
Number of mules and mule colts on farms, by parishes, 1910-1954, Table 33 83
The value in dollars of chickens raised on farms, by parishes, 1910-1954, Table 34 86
The value in dollars of chicken eggs produced on farms, by parishes, 1930, 1950, and 1954, Table 35 89
The value in dollars of chickens and eggs produced on farms, by parishes, 1910, 1920, 1950, and 1954, Table 36 91
Receipts from sale of poultry and eggs, by parishes, 1910-1954, Table 37 93
Number of chickens raised on farms, by parishes, 1910-1954, Table 38 96
Number of dozens of chicken eggs produced on farms, by parishes, 1910-1954, Table 39 99
The value in dollars of chickens (4 months old and older) on farms, by parishes, 1925-1950, Table 40 102

Statistics on Livestock and Livestock Products, By Parishes in Louisiana, Selected Years, 1910-1954

J. P. MONTGOMERY

DEPARTMENT OF AGRICULTURAL ECONOMICS
LOUISIANA AGRICULTURAL EXPERIMENT STATION

The purpose of this publication is to make available basic statistical data on Louisiana's rapidly expanding livestock industry. The data are shown by parishes (counties), Crop Reporting Districts and state totals for major classes of livestock and livestock products as shown in the United States *Census of Agricultuure*, U.S. Department of Commerce, Bureau of the Census. Reports were made at ten-year intervals until 1920, and at five-year intervals since then.

Dates of taking censuses have varied from census to census since 1910, as shown below:

1910—April 1
1920—January 1
1925—January 1
1930—April 1
1935—January 1
1940—April 1
1945—January 1
1950—April 1
1954—Oct.-Nov.

Data are not available for Evangeline, Allen, Beauregard, and Jeff Davis Parishes for the year 1910. Evangeline Parish was formed from part of St. Landry Parish in 1911; therefore data for the present Evangeline were included in St. Landry totals. Allen, Beauregard, and Jeff Davis Parishes were formed by taking parts from Calcasieu Parish, and therefore data for these three parishes were included in Calcasieu Parish totals.

Table 1.--The value in dollars of agricultural products sold by farms, by parishes, 1940-1954

District	Parish	Agricultural census year			
		1940	1945	1950	1954
		Dollars			
1	Bossier	1,921,350	3,054,595	4,855,112	5,216,928
	Caddo	3,399,218	5,176,892	8,890,994	8,585,110
	DeSoto	1,548,209	1,800,441	4,379,276	3,324,090
	Red River	1,138,446	1,814,253	3,217,056	2,823,598
	Webster	986,721	1,092,621	2,221,121	1,309,679
District 1 total		8,993,944	12,938,802	23,563,559	21,259,405
2	Bienville	1,193,640	1,058,152	1,876,741	1,645,733
	Caldwell	401,163	893,757	1,456,310	1,748,864
	Claiborne	1,407,318	1,737,591	2,996,677	1,680,648
	Jackson	402,254	826,597	479,481	785,401
	Lincoln	1,209,230	1,459,713	1,756,428	1,736,628
	Ouachita	1,154,108	2,401,417	3,729,801	4,021,625
	Union	1,142,723	1,778,618	2,075,848	2,110,471
	Winn	409,244	667,332	714,719	522,409
District 2 total		7,319,680	10,823,177	15,086,005	14,251,779
3	E. Carroll	1,720,330	3,778,421	4,241,864	8,397,744
	Franklin	2,401,615	4,828,257	10,285,242	8,861,990
	Madison	1,420,950	3,380,294	3,870,836	6,830,573
	Morehouse	1,767,316	3,461,723	6,662,625	6,978,029
	Richland	1,978,793	4,041,119	7,025,545	7,571,109
	Tensas	1,440,054	3,306,866	4,041,470	7,264,406
	W. Carroll	1,394,379	2,924,132	4,344,725	4,709,006
District 3 total		12,123,437	25,720,812	40,472,307	50,612,857
4	Natchitoches	1,917,265	4,073,240	5,304,060	5,817,183
	Sabine	618,775	591,830	1,449,680	1,393,096
	Vernon	361,384	508,618	1,052,877	1,093,173
District 4 total		2,897,424	5,173,688	7,806,617	8,303,452
5	Avoyelles	2,071,906	4,550,036	6,122,228	8,986,695
	Catahoula	834,552	1,879,321	2,582,242	3,149,751
	Concordia	827,259	1,867,185	2,096,180	3,413,490
	Evangeline	2,162,951	5,054,695	7,052,169	11,014,203
	Grant	410,651	1,006,414	1,295,091	1,324,095
	LaSalle	147,874	175,710	419,527	328,362
	Pt. Coupee	1,865,533	3,849,379	4,297,172	5,389,835
	Rapides	2,244,162	4,140,827	7,180,258	9,741,014
	St. Landry	3,773,720	10,182,249	10,960,193	16,772,153
	W. B. Rouge	750,052	1,351,676	1,973,116	2,216,246
District 5 total		15,088,660	34,057,492	43,978,176	62,335,844

(Continued)

Table 1.--The value in dollars of agricultural products sold by farms, by parishes, 1940-1954--Continued

District	Parish	Agricultural census year			
		1940	1945	1950	1954
		Dollars			
6	E. B. Rouge	936,619	1,422,186	2,299,989	1,440,005
	E. Feliciana	563,564	1,933,615	2,222,089	2,363,358
	Livingston	921,682	1,509,319	1,610,910	1,757,214
	St. Helena	575,761	1,573,878	1,970,942	2,483,988
	St. Tammany	337,178	1,302,267	2,082,919	2,379,049
	Tangipahoa	2,926,895	5,423,329	7,484,828	10,343,527
	Washington	1,037,465	3,146,073	3,682,085	4,742,105
	W. Feliciana	968,299	1,813,409	1,935,254	2,750,640
District 6 total		8,267,463	18,124,076	23,289,016	28,259,886
7	Acadia	4,871,325	10,968,495	11,403,991	18,800,059
	Allen	797,212	1,493,138	2,394,622	4,104,303
	Beauregard	556,244	721,467	1,453,651	1,626,426
	Calcasieu	2,168,957	2,595,597	6,136,857	8,800,157
	Cameron	629,403	1,023,905	1,670,109	2,357,827
	Jeff Davis	3,219,939	7,053,578	10,113,482	15,156,061
	Vermilion	4,102,944	8,677,386	11,327,099	19,472,194
District 7 total		16,346,024	32,533,566	44,499,811	70,317,027
8	Assumption	1,924,630	3,265,327	5,079,793	5,364,393
	Iberia	2,284,865	4,489,296	5,310,014	6,085,592
	Iberville	1,285,651	2,332,143	3,242,748	3,701,813
	Lafayette	2,012,908	5,249,666	6,341,020	8,879,248
	St. Martin	1,653,355	3,467,846	4,566,921	6,094,682
	St. Mary	1,640,416	3,707,989	4,655,110	4,599,703
District 8 total		10,801,825	22,512,267	29,195,606	34,725,431
9	Ascension	992,736	1,604,682	2,663,039	2,573,280
	Jefferson	994,932	1,607,161	1,291,456	1,263,314
	Lafourche	1,921,940	4,317,667	4,499,048	5,329,181
	Orleans	657,221	700,852	623,746	407,444
	Plaquemines	400,236	890,584	1,101,951	923,407
	St. Bernard	142,186	613,698	377,437	247,798
	St. Charles	348,635	590,824	703,357	847,721
	St. James	1,046,262	1,849,327	2,698,390	3,746,531
	St. John	519,886	1,375,704	1,626,373	1,601,380
	Terrebonne	1,231,230	2,127,883	2,254,108	2,784,825
District 9 total		8,255,264	15,678,382	17,838,905	19,724,881
State total		90,093,721	177,562,262	245,730,002	309,790,562

Table 2.--The value in dollars of all livestock on farms, by parishes, 1910-1954

District	Parish	Agricultural census year							
		1910	1920	1930	1935	1940	1945	1950	1954
		Dollars							
1	Bossier	912,248	1,874,239	1,027,971	815,078	1,045,841	1,715,227	2,284,682	1,806,649
	Caddo	1,359,060	2,020,190	1,487,554	1,179,482	1,498,361	2,376,053	3,164,903	2,502,697
	DeSoto	1,083,912	1,806,749	1,219,228	966,726	1,335,924	2,183,357	2,908,232	2,299,730
	Red River	466,973	908,514	617,933	489,959	635,781	987,160	1,314,897	1,039,776
	Webster	644,031	987,503	806,096	639,154	812,216	1,104,299	1,470,926	1,163,158
District 1 total		4,466,224	7,597,195	5,158,782	4,090,399	5,328,123	8,366,096	11,143,640	8,812,010
2	Bienville	777,387	1,387,590	824,763	653,955	866,320	1,272,875	1,695,469	1,340,719
	Caldwell	320,959	611,944	559,048	443,269	483,055	1,088,349	1,449,681	1,146,358
	Claiborne	999,494	1,759,726	1,169,550	927,336	1,106,338	1,502,672	2,001,559	1,582,764
	Jackson	377,965	908,981	484,551	384,200	449,342	691,800	921,478	728,673
	Lincoln	583,763	888,704	885,351	701,995	862,875	1,102,458	1,468,474	1,161,219
	Ouachita	695,008	1,220,663	788,629	625,304	704,986	1,149,862	1,531,616	1,211,150
	Union	704,483	1,315,572	843,861	669,097	980,513	1,487,884	1,981,861	1,567,188
	Winn	467,429	1,058,931	692,258	548,891	602,842	1,144,060	1,523,888	1,205,038
District 2 total		4,926,488	9,152,111	6,248,011	4,954,047	6,056,271	9,439,960	12,574,026	9,943,109
3	E. Carroll	535,779	1,316,664	638,595	506,342	799,862	1,066,091	1,420,033	1,122,914
	Franklin	649,718	2,354,561	1,469,305	1,165,012	1,826,583	2,836,276	3,777,920	2,987,450
	Madison	532,974	976,243	579,280	459,311	766,699	1,170,262	1,558,789	1,232,637
	Morehouse	836,236	1,622,683	1,022,936	811,086	1,153,586	2,131,062	2,838,575	2,244,648
	Richland	694,228	1,633,536	1,035,020	820,667	1,497,050	2,035,206	2,710,894	2,143,682
	Tensas	727,913	1,070,217	612,913	485,978	793,060	1,408,483	1,876,099	1,483,555
	W. Carroll	395,217	676,494	656,766	520,750	1,036,232	1,435,433	1,911,997	1,511,942
District 3 total		4,372,065	9,650,398	6,014,815	4,769,146	7,873,072	12,082,813	16,094,307	12,726,828

(Continued)

Table 2.--The value in dollars of all livestock on farms, by parishes, 1910-1954--Continued

District	Parish	Agricultural census year 1910	1920	1930	1935	1940	1945	1950	1954
		Dollars							
4	Natchitoches	1,138,834	2,260,960	1,655,482	1,312,632	1,681,745	2,334,034	3,108,933	2,458,438
	Sabine	675,912	1,180,220	1,052,307	834,374	825,444	1,445,779	1,925,778	1,522,839
	Vernon	458,152	698,158	804,732	638,072	804,740	1,696,603	2,259,875	1,787,032
District 4 total		2,272,898	4,139,338	3,512,521	2,785,078	3,311,929	5,476,416	7,294,586	5,768,309
5	Avoyelles	1,308,759	2,250,082	1,706,019	1,352,702	1,853,422	4,289,411	5,713,495	4,518,037
	Catahoula	438,374	841,906	925,182	733,577	875,726	1,608,290	2,142,242	1,694,012
	Concordia	579,422	956,295	624,343	495,042	701,643	1,310,139	1,745,105	1,379,969
	Evangeline	---	2,088,105	1,881,062	1,491,494	1,947,825	3,209,288	4,274,772	3,380,343
	Grant	434,818	983,870	599,474	475,323	507,891	1,259,844	1,678,112	1,326,994
	LaSalle	206,069	441,330	448,405	355,540	341,281	824,185	1,097,814	868,114
	Pt. Coupee	653,547	1,804,266	1,087,559	862,326	1,392,394	3,181,111	4,237,240	3,350,664
	Rapides	1,252,702	2,353,045	1,910,078	1,514,500	1,642,197	3,416,218	4,550,402	3,598,302
	St. Landry	2,759,596	3,242,294	2,627,153	2,083,070	3,216,768	5,851,543	7,794,255	6,163,430
	W. B. Rouge	471,275	563,006	200,911	159,302	264,167	637,518	849,174	671,498
District 5 total		8,104,562	15,524,199	12,010,186	9,522,876	12,743,314	25,587,547	34,082,611	26,951,363
6	E. B. Rouge	824,675	1,795,055	1,281,252	1,015,905	1,183,565	2,828,198	3,767,160	2,978,941
	E. Feliciana	732,065	1,612,482	1,249,685	990,875	988,837	2,540,425	3,383,846	2,675,830
	Livingston	319,084	708,744	575,036	455,946	689,673	1,886,266	2,512,506	1,986,804
	St. Helena	295,770	881,596	517,460	410,294	674,238	1,422,426	1,894,671	1,498,241
	St. Tammany	287,526	754,469	599,172	475,083	587,642	1,416,881	1,887,285	1,492,401
	Tangipahoa	600,537	1,618,958	976,676	774,406	1,326,792	3,164,101	4,214,583	3,332,748
	Washington	491,337	1,235,904	938,629	744,238	1,183,871	2,514,355	3,349,121	2,648,370
	W. Feliciana	434,241	1,035,857	722,078	572,536	705,352	1,549,395	2,063,794	1,631,978
District 6 total		3,985,235	9,643,065	6,859,988	5,439,283	7,339,970	17,322,047	23,072,966	18,245,313

(Continued)

Table 2.--The value in dollars of all livestock on farms, by parishes, 1910-1954--Continued

District	Parish	Agricultural census year 1910	1920	1930	1935	1940	1945	1950	1954
		Dollars							
7	Acadia	1,488,040	2,780,454	1,808,683	1,434,105	2,053,210	3,245,548	4,323,070	3,418,536
	Allen	---	700,184	652,455	517,332	711,747	1,222,982	1,629,012	1,288,167
	Beauregard	---	821,891	989,688	784,724	949,654	1,947,944	2,594,661	2,051,769
	Calcasieu	2,401,476	1,077,213	1,294,783	1,026,633	1,456,298	2,231,878	2,972,861	2,350,837
	Cameron	354,908	906,266	776,101	615,370	1,270,294	2,069,025	2,755,941	2,179,304
	Jeff Davis	---	1,924,696	1,406,937	1,115,560	1,499,172	2,500,119	3,330,158	2,633,375
	Vermilion	1,439,942	2,769,983	1,794,006	1,422,467	2,380,763	4,536,435	6,042,531	4,778,227
District 7 total		5,684,366	10,980,687	8,722,653	6,916,191	10,321,138	17,753,931	23,648,234	18,700,215
8	Assumption	661,645	775,747	332,908	263,963	361,628	418,895	557,968	441,222
	Iberia	1,049,747	1,357,041	746,753	592,100	863,507	1,595,153	2,124,744	1,680,175
	Iberville	824,046	1,101,713	418,344	331,705	573,036	920,230	1,225,746	969,278
	Lafayette	1,399,992	1,781,166	1,392,798	1,104,350	1,574,382	3,042,749	4,052,942	3,204,928
	St. Martin	815,693	1,223,473	1,011,031	801,646	1,142,174	1,939,970	2,584,040	2,043,370
	St. Mary	1,150,560	913,488	379,305	300,751	259,566	587,935	783,129	619,272
District 8 total		5,901,683	7,152,628	4,281,139	3,394,515	4,774,293	8,504,932	11,328,569	8,958,245
9	Ascension	460,762	1,080,749	513,637	407,263	622,238	1,379,106	1,836,969	1,452,612
	Jefferson	257,959	353,063	230,465	182,736	295,003	551,665	734,818	581,069
	Lafourche	903,642	1,339,155	681,243	540,158	673,126	1,623,062	2,161,918	1,709,571
	Orleans	292,691	296,069	130,156	103,201	169,459	173,914	231,653	183,184
	Plaquemines	225,476	263,871	182,889	145,013	166,783	338,973	451,512	357,040
	St. Bernard	113,467	65,350	56,858	45,083	64,562	244,242	325,330	257,260
	St. Charles	184,673	318,038	91,166	72,286	157,109	562,656	749,458	592,646
	St. James	510,368	477,757	216,884	171,967	230,999	307,070	409,017	323,437
	St. John	204,221	270,554	148,207	117,513	106,477	249,696	332,595	263,005
	Terrebonne	447,903	904,078	400,715	317,727	376,473	910,250	1,212,453	958,766
District 9 total		3,601,162	5,368,684	2,652,220	2,102,947	2,862,229	6,340,634	8,445,723	6,678,590
State total		43,314,683	79,208,305	55,460,315	43,974,482	60,610,339	110,874,376	147,684,662	116,783,982

Table 3.--Number of farms and livestock sold, by parishes, 1940-1954

District	Parish	1940		1945		1950		1954	
		Number of farms	Livestock sold	Number of farms	Livestock sold	Number of farms	Livestock sold	Number of farms	Livestock sold
1	Bossier	3,079	232,261	2,280	512,722	2,018	701,270	2,020	1,266,594
	Caddo	5,061	610,774	4,534	1,100,431	3,400	1,597,879	2,771	1,769,355
	DeSoto	4,397	324,973	3,085	749,944	2,689	2,238,173	2,575	2,380,401
	Red River	2,338	87,327	1,857	224,634	1,804	561,277	1,551	859,261
	Webster	2,785	157,474	2,071	292,312	1,930	561,156	1,673	728,797
District 1 total		17,660	1,412,809	13,827	2,880,043	11,841	5,659,755	10,590	7,004,408
2	Bienville	3,083	101,030	2,357	230,488	2,126	482,357	1,673	858,420
	Caldwell	1,252	59,839	1,176	133,164	1,111	407,203	1,089	316,048
	Claiborne	3,758	171,006	2,777	466,851	2,568	829,494	2,167	924,809
	Jackson	1,638	92,726	1,353	242,184	993	187,799	1,058	569,315
	Lincoln	2,842	208,850	2,304	300,157	1,949	633,096	1,586	1,176,083
	Ouachita	2,499	268,440	1,884	565,472	1,615	727,301	1,500	998,048
	Union	3,248	161,456	2,607	281,421	1,899	571,377	2,131	1,349,283
	Winn	1,641	106,431	1,334	245,835	1,373	399,702	1,134	352,723
District 2 total		19,961	1,169,778	15,792	2,465,572	13,634	4,238,329	12,338	6,544,729
3	E. Carroll	2,876	61,734	2,302	307,256	2,038	645,582	1,715	732,494
	Franklin	5,865	166,287	4,653	408,601	4,739	1,450,053	4,171	1,538,666
	Madison	2,524	130,192	2,011	281,010	1,669	909,027	1,418	1,163,094
	Morehouse	3,744	87,526	3,282	425,328	3,166	880,902	2,610	898,422
	Richland	4,866	121,769	4,091	227,136	3,585	719,760	3,144	1,031,867
	Tensas	2,371	177,135	1,973	320,055	1,705	1,242,473	1,341	1,229,058
	W. Carroll	3,275	102,739	2,708	254,493	2,570	531,021	2,255	609,148
District 3 total		25,521	847,382	21,020	2,223,879	19,472	6,378,818	16,654	7,202,749

(Continued)

Table 3.--Number of farms and livestock sold, by parishes, 1940-1954--Continued

District	Parish	1940 Number of farms	1940 Livestock sold	1945 Number of farms	1945 Livestock sold	1950 Number of farms	1950 Livestock sold	1954 Number of farms	1954 Livestock sold
4	Natchitoches	4,886	221,652	2,940	378,711	3,564	1,052,513	3,169	1,915,503
	Sabine	2,540	127,791	1,957	237,711	1,918	756,308	1,757	1,113,957
	Vernon	1,885	149,897	2,070	313,650	1,991	698,186	1,723	900,026
District 4 total		9,311	499,340	6,967	930,072	7,473	2,507,007	6,649	3,929,486
5	Avoyelles	5,242	183,855	4,669	883,726	4,563	1,448,386	4,467	1,511,213
	Catahoula	2,219	108,195	2,016	311,519	1,668	679,238	1,578	601,308
	Concordia	1,824	117,344	1,460	248,523	1,308	629,127	1,189	770,887
	Evangeline	4,578	233,758	3,966	425,533	3,892	947,922	3,226	701,823
	Grant	1,423	76,988	1,700	241,939	1,481	574,279	1,322	540,922
	LaSalle	704	69,340	628	110,759	851	302,142	775	232,322
	Pt. Coupee	2,828	237,125	2,888	594,121	2,235	1,327,123	1,917	1,240,328
	Rapides	3,368	525,644	3,541	1,334,620	3,855	2,723,535	3,665	2,950,983
	St. Landry	7,883	438,653	7,164	1,046,596	7,369	1,885,026	6,700	1,805,357
	W. B. Rouge	501	56,710	457	109,887	404	354,422	414	286,212
District 5 total		30,570	2,047,612	28,489	5,307,223	27,626	10,871,200	25,253	10,641,355
6	E. B. Rouge	1,853	702,447	1,956	952,486	1,981	1,794,747	1,704	1,202,624
	E. Feliciana	1,971	323,965	2,098	803,596	1,669	1,459,987	1,460	1,307,631
	Livingston	2,162	132,457	1,897	336,093	2,397	494,290	2,585	859,957
	St. Helena	1,709	246,348	1,460	911,659	1,533	1,411,079	1,534	1,914,500
	St. Tammany	1,245	204,491	1,321	494,454	1,455	762,612	1,405	1,090,744
	Tangipahoa	4,521	702,889	4,238	2,697,694	4,551	4,364,165	3,998	7,348,707
	Washington	3,261	403,233	3,028	1,539,044	3,190	2,634,906	2,950	3,350,000
	W. Feliciana	1,253	174,859	1,079	406,520	801	666,249	648	984,983
District 6 total		17,975	2,890,689	17,077	8,141,546	17,577	13,588,035	16,284	18,059,146

(Continued)

Table 3.--Number of farms and livestock sold, by parishes, 1940-1954--Continued

District	Parish	1940		1945		1950		1954	
		Number of farms	Livestock sold	Number of farms	Livestock sold	Number of farms	Livestock sold	Number of farms	Livestock sold
7	Acadia	3,937	288,924	3,517	511,891	3,346	1,291,012	3,310	1,117,812
	Allen	1,302	170,944	872	273,965	1,295	601,376	1,160	680,761
	Beauregard	1,709	359,293	1,562	533,541	1,702	1,017,431	1,262	956,246
	Calcasieu	1,776	386,325	1,598	503,762	1,896	1,833,851	1,296	1,220,594
	Cameron	852	143,226	823	234,939	592	563,316	649	491,291
	Jeff Davis	1,665	289,811	1,237	458,061	1,553	1,263,728	1,207	1,042,273
	Vermilion	3,392	325,962	3,186	622,601	3,180	1,668,996	2,648	1,528,170
District 7 total		14,633	1,964,485	12,795	3,138,760	13,564	8,239,710	11,532	7,037,147
8	Assumption	551	77,628	359	46,074	409	126,009	313	137,929
	Iberia	1,314	201,628	1,308	566,315	1,069	1,000,907	1,002	1,047,420
	Iberville	741	140,321	645	231,610	681	735,664	572	661,446
	Lafayette	3,441	257,739	3,152	637,978	2,977	1,268,041	2,928	1,541,171
	St. Martin	2,440	163,399	2,063	315,903	2,238	622,842	2,198	618,087
	St. Mary	387	55,844	408	125,842	391	103,024	417	126,415
District 8 total		8,874	896,559	7,935	1,923,722	7,765	3,856,487	7,430	4,132,468
9	Ascension	1,411	153,975	1,368	323,091	1,455	553,019	1,283	523,417
	Jefferson	284	914,862	320	1,397,327	254	1,086,767	218	749,808
	Lafourche	1,120	158,728	1,159	298,032	1,058	395,527	736	432,323
	Orleans	199	488,442	150	457,249	110	325,666	40	216,714
	Plaquemines	602	75,343	635	76,193	596	202,800	594	320,578
	St. Bernard	111	82,854	148	230,578	170	170,538	153	87,698
	St. Charles	253	125,326	369	285,848	259	385,125	161	374,469
	St. James	434	32,111	318	32,448	406	94,035	413	174,657
	St. John	181	18,916	225	123,875	195	90,749	141	82,448
	Terrebonne	917	101,536	701	173,333	726	238,396	658	336,218
District 9 total		5,512	2,152,093	5,393	3,397,974	5,229	3,542,622	4,397	3,298,330
State total		150,017	13,880,747	129,295	30,408,791	124,181	58,881,963	111,127	67,849,818

Table 4.--The value in dollars of all cattle and calves on farms, by parishes, 1910-1954

Dist-rict	Parish	Agricultural census year						
		1910	1920	1930	1940	1945	1950	1954
		Dollars						
1	Bossier	214,587	477,300	418,445	412,650	1,121,088	1,915,091	2,068,113
	Caddo	326,478	523,613	556,689	530,120	1,578,038	2,746,356	2,434,464
	DeSoto	302,266	559,423	582,834	566,695	1,444,105	3,578,044	2,688,276
	Red River	112,218	219,479	193,369	194,920	549,802	1,468,085	1,468,117
	Webster	146,604	245,586	317,422	266,370	585,787	1,301,526	1,063,615
District 1 total		1,102,153	2,025,401	2,068,759	1,970,755	5,278,820	11,009,102	9,722,585
2	Bienville	171,796	378,518	288,159	262,906	686,950	1,251,862	1,027,538
	Caldwell	114,252	213,706	200,507	181,627	613,544	775,881	861,736
	Claiborne	207,196	533,721	500,295	369,183	780,052	1,782,279	1,368,721
	Jackson	98,457	300,434	203,664	161,267	332,486	414,551	437,918
	Lincoln	141,944	312,526	404,581	305,873	580,312	1,018,294	808,952
	Ouachita	161,575	454,258	332,504	260,548	642,471	1,028,317	1,111,184
	Union	164,088	425,116	333,427	335,802	780,423	1,197,382	1,199,194
	Winn	164,652	434,252	271,945	254,339	615,703	741,701	664,167
District 2 total		1,223,960	3,052,531	2,535,082	2,131,545	5,031,941	8,210,267	7,479,410
3	E. Carroll	68,902	307,938	136,582	151,077	442,722	905,486	1,094,955
	Franklin	244,823	617,587	469,879	621,601	1,586,307	3,536,434	3,054,467
	Madison	87,248	266,740	164,536	235,232	587,322	1,369,288	1,543,569
	Morehouse	181,719	471,384	375,557	340,734	1,125,450	1,924,218	1,601,036
	Richland	208,544	452,039	280,054	428,813	1,055,798	2,134,212	1,958,181
	Tensas	124,984	303,832	171,777	286,305	779,170	2,033,565	1,734,859
	W. Carroll	127,365	209,670	206,324	237,968	592,923	1,199,299	1,128,903
District 3 total		1,043,585	2,629,190	1,804,709	2,301,730	6,169,692	13,102,502	12,115,970

(Continued)

Table 4.--The value in dollars of all cattle and calves on farms, by parishes, 1910-1954--Continued

District	Parish	Agricultural census year						
		1910	1920	1930	1940	1945	1950	1954
		Dollars						
4	Natchitoches	297,322	651,729	587,123	644,658	1,429,780	3,195,308	3,049,678
	Sabine	256,726	454,895	478,888	383,661	909,484	1,741,630	1,395,379
	Vernon	216,658	370,896	400,911	406,319	1,062,369	1,656,174	1,667,069
District 4 total		770,706	1,477,520	1,466,922	1,434,638	3,401,633	6,593,112	6,112,126
5	Avoyelles	368,656	682,390	694,140	731,070	2,547,238	3,665,238	3,112,359
	Catahoula	133,137	239,247	335,075	371,349	939,887	1,640,729	1,603,430
	Concordia	113,380	233,033	248,801	289,566	839,656	1,379,939	1,631,578
	Evangeline	---	748,357	847,605	879,732	1,842,255	3,331,703	2,292,074
	Grant	146,498	436,857	255,069	223,326	797,280	1,132,600	912,658
	LaSalle	86,892	209,210	222,222	185,112	551,815	772,491	627,506
	Pt. Coupee	167,610	529,236	461,100	667,467	1,963,714	3,119,297	3,445,478
	Rapides	389,361	880,514	962,978	825,273	2,270,772	4,230,086	3,542,615
	St. Landry	868,637	991,361	891,856	1,147,743	2,728,887	4,575,782	3,700,383
	W. B. Rouge	44,408	95,907	59,261	74,763	391,614	702,684	527,630
District 5 total		2,318,579	5,046,112	4,978,107	5,395,401	14,873,118	24,550,549	20,395,711
6	E. B. Rouge	282,420	1,004,820	835,022	783,868	2,247,716	3,162,128	1,823,453
	E. Feliciana	256,842	835,925	768,068	595,446	1,890,346	2,892,758	1,989,362
	Livingston	147,395	360,837	296,834	363,592	1,291,782	1,206,372	1,301,517
	St. Helena	112,160	475,345	319,840	423,592	1,063,310	1,680,606	1,409,214
	St. Tammany	181,149	460,050	341,721	370,432	945,620	1,330,128	1,247,668
	Tangipahoa	287,983	971,349	522,827	773,894	2,236,981	3,896,060	3,579,224
	Washington	177,850	545,440	427,224	555,000	1,565,694	2,672,103	2,299,630
	W. Feliciana	128,859	462,882	412,717	364,938	1,031,101	1,615,708	1,178,814
District 6 total		1,574,658	5,116,648	3,924,253	4,230,762	12,272,550	18,455,863	14,828,882

(Continued)

Table 4.--The value in dollars of all cattle and calves on farms, by parishes, 1910-1954--Continued

Dist-rict	Parish	Agricultural census year						
		1910	1920	1930	1940	1945	1950	1954
		Dollars						
7	Acadia	464,543	824,539	678,196	1,024,928	1,959,303	3,931,968	2,939,480
	Allen	---	362,434	324,844	407,666	860,359	1,579,864	1,222,500
	Beauregard	---	391,753	354,108	426,637	1,095,720	1,666,424	1,436,404
	Calcasieu	999,273	539,194	772,681	941,141	1,642,273	6,104,558	3,477,220
	Cameron	248,367	730,118	552,479	1,043,428	1,695,093	2,720,466	2,426,429
	Jeff Davis	---	778,374	791,657	998,623	1,979,504	4,785,048	3,013,761
	Vermilion	473,099	859,729	746,886	1,360,703	3,079,080	5,609,928	3,436,142
District 7 total		2,185,282	4,486,141	4,220,851	6,203,126	12,311,332	26,398,256	17,951,936
8	Assumption	33,665	38,057	67,167	86,668	103,440	216,271	143,561
	Iberia	164,212	316,332	331,003	313,004	791,284	1,234,258	1,074,948
	Iberville	50,055	139,968	133,811	244,585	560,776	1,481,485	1,162,053
	Lafayette	318,688	483,754	479,701	509,186	1,588,532	2,339,692	1,787,005
	St. Martin	150,031	332,579	428,945	366,810	906,182	1,272,373	1,021,313
	St. Mary	69,711	102,871	91,659	67,447	279,060	325,526	298,242
District 8 total		786,362	1,413,561	1,532,286	1,587,700	4,229,274	6,869,605	5,487,122
9	Ascension	106,503	327,673	242,496	308,219	918,174	1,467,957	1,110,173
	Jefferson	100,018	236,950	189,210	243,217	463,827	578,992	367,415
	Lafourche	93,957	274,963	293,243	233,928	899,757	1,321,481	1,022,696
	Orleans	162,498	220,377	119,596	148,978	126,133	162,419	55,924
	Plaquemines	40,409	60,061	139,981	99,836	233,032	511,396	302,552
	St. Bernard	15,761	12,775	42,086	32,910	181,628	87,114	88,595
	St. Charles	15,496	45,146	40,183	65,638	445,731	527,548	403,864
	St. James	23,685	26,569	61,827	60,521	119,698	240,145	264,188
	St. John	12,773	18,111	27,370	19,414	87,219	88,694	70,290
	Terrebonne	32,969	150,866	147,578	122,845	477,634	566,399	684,227
District 9 total		604,069	1,373,491	1,303,570	1,335,506	3,952,833	5,552,145	4,369,924
State total		11,609,354	26,620,595	23,834,539	26,591,163	67,521,193	120,741,401	98,463,666

Table 5.--Number of farms reporting cattle, by parishes, 1910-1954

District	Parish	Agricultural census year							
		1910	1920	1930	1935	1940	1945	1950	1954
		Number							
1	Bossier	2,388	2,800	2,141	2,700	2,114	1,575	1,338	1,551
	Caddo	3,449	3,248	3,087	3,862	3,050	2,793	1,849	1,748
	DeSoto	3,182	2,983	2,571	3,135	3,170	2,523	2,066	2,204
	Red River	1,296	1,597	1,548	1,746	1,467	1,123	1,168	966
	Webster	1,606	1,770	2,278	2,941	2,123	1,788	1,587	1,424
District 1 total		11,921	12,398	11,625	14,384	11,924	9,802	8,008	7,893
2	Bienville	2,105	1,979	2,412	2,783	2,409	1,974	1,779	1,502
	Caldwell	677	738	793	1,127	1,055	1,061	935	941
	Claiborne	2,800	2,666	3,063	3,536	2,831	2,377	2,009	1,754
	Jackson	1,193	1,332	1,222	1,355	1,363	1,220	861	960
	Lincoln	1,681	1,489	2,305	2,570	2,263	1,804	1,552	1,370
	Ouachita	1,539	1,766	1,436	1,760	1,692	1,429	1,168	1,157
	Union	2,047	2,270	2,308	2,863	2,788	2,386	1,558	1,806
	Winn	1,198	1,086	1,333	1,813	1,453	1,274	1,134	1,016
District 2 total		13,240	13,326	14,872	17,807	15,854	13,525	10,996	10,506
3	E. Carroll	1,311	1,514	1,004	1,371	1,542	1,364	1,058	814
	Franklin	1,332	3,042	3,048	4,007	4,011	3,444	3,024	2,853
	Madison	1,262	1,372	728	980	1,119	1,116	879	782
	Morehouse	2,166	2,146	1,558	2,001	2,038	2,331	1,746	1,452
	Richland	1,701	2,241	2,056	3,100	3,030	2,720	2,331	2,028
	Tensas	2,051	1,384	853	1,161	1,066	1,061	832	706
	W. Carroll	693	978	1,256	2,201	2,401	2,195	1,947	1,731
District 3 total		10,516	12,677	10,503	14,821	15,207	14,231	11,817	10,366

(Continued)

Table 5.--Number of farms reporting cattle, by parishes, 1910-1954--Continued

District	Parish	Agricultural census year							
		1910	1920	1930	1935	1940	1945	1950	1954
		Number							
4	Natchitoches	3,481	3,583	3,186	3,962	3,233	2,209	2,405	2,298
	Sabine	1,812	1,756	2,057	2,745	2,077	1,812	1,698	1,658
	Vernon	896	846	1,463	2,009	1,644	1,935	1,616	1,567
District 4 total		6,189	6,185	6,706	8,716	6,954	5,956	5,719	5,523
5	Avoyelles	3,260	3,729	3,390	4,137	3,826	3,976	3,673	3,557
	Catahoula	1,027	1,210	1,080	1,354	1,491	1,895	1,130	1,199
	Concordia	961	1,344	713	1,036	1,086	894	705	650
	Evangeline	---	2,352	3,464	3,869	4,025	3,771	3,097	2,651
	Grant	1,039	1,092	1,258	1,528	1,076	1,428	1,102	1,091
	LaSalle	496	492	721	851	648	617	756	719
	Pt. Coupee	1,109	2,188	1,203	1,283	1,930	2,373	1,346	1,182
	Rapides	2,035	2,231	2,446	3,511	2,372	2,716	2,925	2,951
	St. Landry	6,132	4,356	4,643	5,358	6,401	6,292	5,680	5,352
	W. B. Rouge	400	266	185	218	295	340	289	313
District 5 total		16,459	19,260	19,103	23,145	23,150	24,302	20,703	19,665
6	E. B. Rouge	1,513	1,608	1,437	1,684	1,449	1,727	1,656	1,545
	E. Feliciana	1,684	1,593	1,446	1,578	1,367	1,620	1,300	1,152
	Livingston	809	869	1,272	1,713	1,642	1,704	1,786	2,003
	St. Helena	877	962	1,061	1,127	1,334	1,268	1,243	1,268
	St. Tammany	443	445	812	1,113	997	1,093	1,064	1,096
	Tangipahoa	1,483	1,812	1,964	2,792	2,769	3,226	2,977	2,887
	Washington	1,214	1,434	1,849	2,414	2,602	2,652	2,668	2,632
	W. Feliciana	1,100	1,171	1,027	933	821	878	588	453
District 6 total		9,123	9,894	10,868	13,354	12,981	14,168	13,282	13,036

(Continued)

Table 5.--Number of farms reporting cattle, by parishes, 1910-1954--Continued

Dist-rict	Parish	Agricultural census year							
		1910	1920	1930	1935	1940	1945	1950	1954
		Number							
7	Acadia	2,281	2,046	2,706	3,380	3,464	3,331	2,922	2,835
	Allen	---	499	817	1,051	1,078	782	1,006	1,026
	Beauregard	---	585	995	1,259	1,399	1,466	1,356	1,154
	Calcasieu	2,265	611	1,147	1,570	1,553	1,440	1,543	1,081
	Cameron	423	411	624	810	684	790	542	592
	Jeff Davis	---	770	1,200	1,310	1,367	1,139	1,324	1,098
	Vermilion	2,048	1,960	2,900	3,632	3,051	2,952	2,822	2,406
District 7 total		7,017	6,882	10,389	13,012	12,596	11,900	11,515	10,192
8	Assumption	317	290	304	357	471	330	319	244
	Iberia	1,206	981	966	1,343	1,195	1,221	924	876
	Iberville	431	443	330	538	459	516	476	428
	Lafayette	2,277	2,019	2,725	3,210	3,053	2,966	2,578	2,595
	St. Martin	1,585	1,329	1,583	2,319	2,034	1,968	1,884	1,968
	St. Mary	481	272	417	392	307	338	284	381
District 8 total		6,297	5,334	6,325	8,159	7,519	7,339	6,465	6,492
9	Ascension	828	1,080	1,015	1,063	1,106	1,187	1,241	1,155
	Jefferson	258	221	159	284	206	263	170	163
	Lafourche	871	788	889	1,052	912	1,072	855	577
	Orleans	307	163	114	200	135	81	42	16
	Plaquemines	441	378	120	193	235	318	184	123
	St. Bernard	101	802	41	144	55	83	79	70
	St. Charles	201	171	118	209	179	307	172	128
	St. James	251	191	247	470	314	245	271	276
	St. John	146	150	110	223	121	161	119	89
	Terrebonne	389	566	484	777	673	646	598	557
District 9 total		3,793	4,510	3,297	4,615	3,936	4,363	3,731	3,154
State total		84,555	90,466	93,688	118,013	110,121	105,586	92,236	86,827

Table 6.--Number of cattle and calves on farms, by parishes, 1910-1954

Dist-: rict :	Parish	Agricultural Census year 1910	1920	1930	1935	1940	1945	1950	1954
					Number				
1	Bossier	16,856	16,227	11,086	18,459	19,601	26,408	21,900	38,867
	Caddo	23,639	16,579	13,494	23,323	22,710	40,060	29,696	45,752
	DeSoto	23,632	18,825	14,874	22,297	24,820	35,305	38,831	50,522
	Red River	9,059	8,858	4,762	8,318	9,275	13,351	16,133	27,591
	Webster	11,163	8,701	8,110	16,074	11,542	14,674	14,719	19,989
District 1 total		84,349	69,190	52,326	88,471	87,948	129,798	121,279	182,721
2	Bienville	12,423	13,145	7,110	13,252	10,939	16,252	14,662	19,311
	Caldwell	10,340	7,907	5,349	8,189	8,186	15,018	9,217	16,195
	Claiborne	14,851	19,377	13,315	23,597	15,225	19,278	20,871	25,723
	Jackson	8,314	10,052	5,280	7,449	6,905	8,602	4,826	8,230
	Lincoln	9,743	10,439	10,403	15,759	12,661	13,992	11,873	15,203
	Ouachita	11,622	11,916	8,698	11,517	10,824	15,897	11,740	20,883
	Union	13,209	17,186	8,901	16,087	15,350	20,164	13,697	22,537
	Winn	12,781	13,345	7,295	12,262	11,396	14,801	8,581	12,482
District 2 total		93,283	103,367	66,351	108,112	91,486	124,004	95,467	140,564
3	E. Carroll	3,877	7,349	3,501	8,226	5,461	11,769	9,785	20,578
	Franklin	18,787	18,829	12,271	24,171	24,374	39,353	38,065	57,404
	Madison	5,968	8,269	4,582	10,612	9,835	15,397	14,089	29,009
	Morehouse	15,961	17,202	10,365	15,133	13,194	29,961	20,744	30,089
	Richland	17,525	13,017	7,309	16,610	15,436	25,823	23,103	36,801
	Tensas	8,189	7,817	4,601	11,319	11,861	19,210	21,827	32,604
	W. Carroll	11,257	6,885	5,276	13,061	8,696	14,801	12,920	21,216
District 3 total		81,564	79,368	47,905	99,132	88,857	156,314	140,533	227,701

(Continued)

Table 6.--Number of cattle and calves on farms, by parishes, 1910-1954--Continued

District	Parish	Agricultural census year							
		1910	1920	1930	1935	1940	1945	1950	1954
		Number							
4	Natchitoches	22,053	23,289	15,006	25,528	27,613	35,077	35,601	57,314
	Sabine	17,978	17,481	12,386	20,550	15,845	22,436	19,427	26,224
	Vernon	17,020	13,608	11,033	18,413	18,635	25,894	17,935	31,330
District 4 total		57,051	54,378	38,425	64,491	62,093	83,407	72,963	114,868
5	Avoyelles	24,268	21,509	17,355	30,220	28,687	54,858	38,856	58,492
	Catahoula	10,989	8,527	9,027	14,828	14,871	22,363	16,732	30,134
	Concordia	8,089	7,647	6,849	13,992	12,691	20,008	14,559	30,663
	Evangeline	---	21,797	20,225	34,296	34,988	40,425	33,895	43,076
	Grant	10,582	13,646	6,131	11,447	8,749	17,508	11,903	17,152
	LaSalle	7,564	7,414	5,732	8,767	7,610	11,823	8,271	11,793
	Pt. Coupee	11,306	16,415	12,494	17,749	28,212	40,388	31,819	45,959
	Rapides	28,775	26,410	24,988	37,515	33,063	49,759	44,370	66,578
	St. Landry	57,890	31,030	21,905	41,049	44,503	57,927	48,192	69,543
	W. B. Rouge	2,283	3,305	1,555	1,920	2,997	7,163	7,323	9,916
District 5 total		161,746	157,700	126,261	211,783	216,371	322,222	255,920	383,306
6	E. B. Rouge	19,234	27,561	22,467	25,947	30,412	39,404	35,130	34,269
	E. Feliciana	19,487	24,642	19,931	26,274	23,801	37,009	31,474	37,387
	Livingston	10,863	13,867	7,440	13,398	14,708	23,749	13,762	24,460
	St. Helena	8,361	14,114	7,952	12,304	15,568	21,416	18,928	26,484
	St. Tammany	11,331	11,702	8,837	12,623	15,552	19,147	14,764	23,448
	Tangipahoa	15,894	22,181	12,203	22,298	26,124	42,964	42,666	67,266
	Washington	14,275	16,758	10,451	19,544	19,760	32,608	30,547	43,218
	W. Feliciana	8,575	14,193	10,994	15,161	15,262	20,187	17,467	22,154
District 6 total		108,020	145,018	100,275	147,549	161,187	236,484	204,738	278,686

(Continued)

Table 6.--Number of cattle and calves on farms, by parishes, 1910-1954--Continued

District	Parish	1910	1920	1930	1935	1940	1945	1950	1954
		Number							
7	Acadia	31,436	24,357	17,379	41,320	39,533	44,939	39,218	55,243
	Allen	---	11,993	8,641	15,567	15,324	18,901	15,124	22,975
	Beauregard	---	12,446	9,751	13,675	15,824	24,568	17,203	26,995
	Calcasieu	68,470	14,257	22,078	48,104	38,154	35,664	58,607	65,349
	Cameron	16,546	17,839	16,090	43,565	41,914	36,993	26,632	45,601
	Jeff Davis	---	20,370	22,011	38,537	39,119	42,416	46,243	56,639
	Vermilion	28,503	23,858	19,099	48,290	50,376	64,759	55,279	64,577
District 7 total		144,955	125,120	115,049	249,058	240,244	268,240	258,306	337,379
8	Assumption	1,915	1,330	1,682	3,066	2,884	2,202	2,357	2,698
	Iberia	8,431	8,406	8,554	17,057	10,826	16,216	13,460	20,202
	Iberville	2,790	4,686	3,674	7,280	9,727	10,540	16,151	21,839
	Lafayette	17,838	13,847	11,773	24,422	17,978	29,809	25,639	33,584
	St. Martin	9,130	8,905	11,260	12,182	13,382	17,302	14,055	19,194
	St. Mary	2,994	1,862	2,265	3,451	2,639	5,014	3,591	5,605
District 8 total		43,098	39,036	39,208	67,458	57,436	81,083	75,253	103,122
9	Ascension	7,779	10,256	5,988	8,379	11,885	17,289	16,392	20,864
	Jefferson	3,770	2,756	4,188	6,429	6,964	7,943	5,972	6,905
	Lafourche	6,540	7,026	7,992	7,096	8,881	16,623	14,342	19,220
	Orleans	5,375	2,866	2,562	4,637	4,654	2,339	1,592	1,051
	Plaquemines	2,076	1,398	3,611	2,983	3,735	4,457	5,369	5,686
	St. Bernard	597	255	1,141	1,258	991	3,410	918	1,665
	St. Charles	698	1,002	1,070	3,589	2,143	8,697	5,815	7,590
	St. James	1,093	801	1,606	2,750	2,172	2,468	2,663	4,965
	St. John	679	515	670	1,624	608	1,617	953	1,321
	Terrebonne	2,122	4,189	3,875	6,898	4,246	9,030	6,141	12,859
District 9 total		30,729	31,064	32,703	45,643	46,279	73,873	60,157	82,126
State total		804,795	804,241	618,503	1,081,697	1,051,901	1,475,425	1,284,616	1,850,473

Table 7.--Number of farms reporting cows, including heifers two years and over, 1930-1954

Dist-rict	Parish	Agricultural census year					
		1930	1935	1940	1945	1950	1954
		Number					
1	Bossier	2,073	2,500	1,999	1,523	1,301	1,520
	Caddo	2,979	3,712	2,981	2,592	1,748	1,678
	DeSoto	2,471	3,032	3,060	2,442	1,995	2,151
	Red River	1,503	1,696	1,421	1,012	1,146	950
	Webster	2,129	2,868	1,931	1,755	1,543	1,394
District 1 total		11,155	13,808	11,392	9,324	7,733	7,693
2	Bienville	2,309	2,715	2,360	1,947	1,741	1,478
	Caldwell	742	1,092	1,022	1,040	899	927
	Claiborne	2,998	3,461	2,782	2,339	1,966	1,721
	Jackson	1,182	1,326	1,339	1,168	840	937
	Lincoln	2,251	2,507	2,230	1,771	1,518	1,341
	Ouachita	1,324	1,699	1,650	1,377	1,132	1,111
	Union	2,190	2,812	2,763	2,346	1,536	1,776
	Winn	1,369	1,772	1,444	1,258	1,108	990
District 2 total		14,365	17,384	15,590	13,246	10,740	10,281
3	E. Carroll	987	1,266	1,471	1,306	1,027	797
	Franklin	2,863	3,862	3,756	3,402	2,970	2,795
	Madison	679	915	1,065	1,100	838	763
	Morehouse	1,510	1,926	1,955	2,237	1,711	1,396
	Richland	1,969	2,991	2,952	2,595	2,247	1,990
	Tensas	853	1,111	1,001	1,013	789	690
	W. Carroll	1,203	2,125	2,346	2,175	1,888	1,705
District 3 total		10,064	14,196	14,546	13,828	11,470	10,136
4	Natchitoches	3,072	3,851	3,076	2,143	2,273	2,257
	Sabine	2,065	2,691	2,041	1,787	1,663	1,643
	Vernon	1,488	1,968	1,604	1,910	1,567	1,548
District 4 total		6,625	8,510	6,721	5,840	5,503	5,448
5	Avoyelles	3,487	4,044	3,700	3,933	3,609	3,507
	Catahoula	1,106	1,315	1,418	1,889	1,099	1,174
	Concordia	661	999	1,030	855	656	628
	Evangeline	3,620	3,831	3,983	3,743	3,066	2,626
	Grant	1,266	1,506	1,049	1,413	1,074	1,068
	LaSalle	713	843	629	605	738	707
	Pt. Coupee	1,285	1,204	1,853	2,342	1,312	1,156
	Rapides	2,521	3,450	2,313	2,630	2,844	2,892
	St. Landry	4,620	5,197	6,276	6,192	5,571	5,265
	W. B. Rouge	186	207	283	329	281	302
District 5 total		19,465	22,596	22,534	23,931	20,250	19,325

(Continued)

Table 7.--Number of farms reporting cows, including heifers two years and over, 1930-1954--Continued

District	Parish	Agricultural census year					
		1930	1935	1940	1945	1950	1954
		Number					
6	E. B. Rouge	1,591	1,643	1,391	1,664	1,586	1,489
	E. Feliciana	1,553	1,531	1,214	1,580	1,278	1,126
	Livingston	1,324	1,637	1,610	1,679	1,736	1,921
	St. Helena	1,035	1,098	1,293	1,234	1,205	1,211
	St. Tammany	846	1,083	928	1,064	1,034	1,015
	Tangipahoa	1,880	2,665	2,676	3,083	2,851	2,708
	Washington	1,833	2,363	2,561	2,601	2,576	2,486
	W. Feliciana	1,081	905	792	862	573	435
District 6 total		11,143	12,925	12,465	13,767	12,839	12,391
7	Acadia	2,823	3,328	3,371	3,301	2,884	2,803
	Allen	895	1,031	985	746	992	1,003
	Beauregard	1,048	1,231	1,296	1,433	1,320	1,128
	Calcasieu	1,165	1,541	1,494	1,434	1,490	1,059
	Cameron	656	803	675	782	533	586
	Jeff Davis	1,269	1,293	1,335	1,119	1,301	1,091
	Vermilion	2,963	3,620	2,993	2,884	2,794	2,393
District 7 total		10,819	12,847	12,149	11,699	11,314	10,063
8	Assumption	303	352	465	282	314	238
	Iberia	961	1,333	1,173	1,200	913	857
	Iberville	334	517	418	512	463	419
	Lafayette	2,642	3,187	3,001	2,944	2,559	2,565
	St. Martin	1,543	2,296	2,000	1,948	1,854	1,950
	St. Mary	395	382	303	332	267	379
District 8 total		6,178	8,067	7,360	7,218	6,370	6,408
9	Ascension	1,013	1,034	1,079	1,176	1,219	1,134
	Jefferson	164	277	201	258	157	150
	Lafourche	881	1,031	877	1,049	833	564
	Orleans	113	200	134	75	40	16
	Plaquemines	125	192	225	300	172	111
	St. Bernard	41	139	54	81	74	64
	St. Charles	142	198	164	295	163	124
	St. James	255	460	286	224	260	265
	St. John	110	216	117	159	113	86
	Terrebonne	497	758	648	629	585	541
District 9 total		3,341	4,505	3,785	4,246	3,616	3,055
State total		93,155	114,838	106,542	103,099	89,835	84,800

Table 8.--Number of cows on farms including heifers that have calved, by parishes, 1910-1954

Dist-rict	Parish	Agricultural census year							
		1910	1920	1930	1935	1940	1945	1950	1954
		Number							
1	Bossier	9,561	8,753	5,692	9,509	8,820	17,003	11,118	22,981
	Caddo	14,086	9,007	8,662	13,213	13,673	19,093	17,103	26,541
	DeSoto	13,661	10,697	8,311	11,784	14,150	21,047	22,539	31,737
	Red River	5,127	4,454	3,061	3,913	4,103	8,001	9,032	18,044
	Webster	6,894	4,676	4,706	8,551	6,567	8,243	7,879	11,300
District 1 total		49,329	37,587	30,432	46,970	47,313	73,387	67,671	110,603
2	Bienville	7,162	6,796	4,301	6,664	6,847	10,238	7,933	10,972
	Caldwell	5,742	3,964	2,719	3,920	4,068	8,728	4,917	8,893
	Claiborne	8,948	9,921	7,194	11,969	8,930	11,335	11,157	14,836
	Jackson	4,737	5,155	2,797	3,823	3,716	4,488	2,574	4,466
	Lincoln	5,730	5,343	5,749	8,568	7,432	8,078	6,382	8,550
	Ouachita	6,786	6,208	4,781	6,066	6,646	9,228	6,445	11,434
	Union	7,771	8,494	4,925	7,757	6,856	10,919	7,609	12,470
	Winn	7,116	7,072	3,923	6,358	6,213	8,880	4,765	7,000
District 2 total		53,992	52,953	36,389	55,125	50,708	71,894	51,782	78,621
3	E. Carroll	2,184	3,468	2,272	4,043	3,626	5,390	5,223	11,541
	Franklin	9,440	10,819	6,685	11,314	12,638	23,808	20,952	33,260
	Madison	3,528	4,064	2,281	5,408	4,415	7,461	8,325	16,190
	Morehouse	8,394	8,957	5,555	7,752	7,092	14,436	11,164	16,875
	Richland	10,105	7,364	4,194	7,842	9,630	15,376	12,420	20,707
	Tensas	4,145	4,106	2,712	5,168	6,001	11,104	11,761	16,603
	W. Carroll	6,680	3,486	3,087	6,137	5,038	8,054	7,091	11,695
District 3 total		44,476	42,264	26,786	47,664	48,440	85,629	76,936	126,871

(Continued)

Table 8.--Number of cows on farms including heifers that have calved, by parishes, 1910-1954--Continued

District	Parish	Agricultural census year							
		1910	1920	1930	1935	1940	1945	1950	1954
		Number							
4	Natchitoches	13,491	12,631	8,435	12,053	14,554	20,987	19,906	33,806
	Sabine	10,180	9,919	6,535	10,041	8,003	14,270	10,745	15,869
	Vernon	9,130	7,248	6,160	9,244	7,591	15,565	10,213	17,480
District 4 total		32,801	29,798	21,130	31,338	30,148	50,822	40,864	67,155
5	Avoyelles	15,077	11,434	9,693	14,361	14,375	34,673	21,430	33,033
	Catahoula	6,295	4,489	4,369	6,656	6,996	12,140	9,920	17,454
	Concordia	4,357	3,569	2,740	6,264	4,655	11,792	7,308	16,607
	Evangeline	---	11,576	12,481	17,145	16,093	24,495	20,478	26,809
	Grant	5,709	6,449	3,554	5,710	4,596	10,724	6,485	9,772
	LaSalle	4,046	4,024	2,978	4,747	3,270	7,885	4,343	6,773
	Pt. Coupee	5,860	7,641	6,779	9,845	13,666	24,014	18,712	27,667
	Rapides	16,892	14,427	13,649	20,111	16,911	31,340	24,836	36,805
	St. Landry	33,323	16,049	12,777	20,029	22,110	31,788	26,925	38,518
	W. B. Rouge	1,299	1,528	895	1,137	1,497	4,909	4,239	6,316
District 5 total		92,858	81,186	69,915	106,005	104,169	193,760	144,676	219,754
6	E. B. Rouge	10,458	14,632	13,191	15,827	18,639	28,042	21,034	21,416
	E. Feliciana	10,927	12,941	12,150	15,096	12,401	25,623	19,126	22,664
	Livingston	6,526	7,640	4,869	7,860	7,911	16,495	7,746	13,760
	St. Helena	4,543	7,217	4,799	6,784	9,251	14,266	10,968	15,269
	St. Tammany	6,467	7,137	5,852	7,564	8,317	12,797	8,826	13,901
	Tangipahoa	8,512	12,810	7,915	13,618	17,499	28,315	25,804	39,749
	Washington	7,814	9,471	6,203	10,822	12,075	20,002	17,061	24,525
	W. Feliciana	5,211	7,229	6,460	9,013	8,519	13,976	10,718	12,857
District 6 total		60,458	79,077	61,439	86,584	94,612	159,516	121,283	164,141

(Continued)

Table 8.--Number of cows on farms including heifers that have calved, by parishes, 1910-1954--Continued

District	Parish	1910	1920	1930	1935	1940	1945	1950	1954
		Number							
7	Acadia	18,150	13,862	9,780	22,832	15,712	26,571	23,990	32,938
	Allen	---	6,159	5,249	8,298	7,884	13,068	10,061	14,786
	Beauregard	---	6,110	5,250	6,695	8,403	14,945	9,744	16,728
	Calcasieu	37,539	8,091	11,739	25,099	13,569	20,041	38,194	44,789
	Cameron	9,157	10,787	8,755	26,153	19,442	23,048	16,408	28,762
	Jeff Davis	---	11,519	13,356	23,180	18,617	27,692	30,083	38,484
	Vermilion	17,287	12,077	11,676	26,750	25,517	37,877	34,290	40,755
District 7 total		82,133	68,605	65,805	139,007	109,144	163,242	162,770	217,242
8	Assumption	1,152	762	978	1,660	1,928	1,068	1,357	1,799
	Iberia	5,368	4,324	4,844	10,040	6,675	9,172	7,812	12,423
	Iberville	1,353	2,140	1,873	4,134	4,574	6,501	8,289	12,853
	Lafayette	11,554	7,061	6,860	12,960	9,762	17,629	14,706	20,272
	St. Martin	5,469	4,696	7,024	6,316	7,516	9,020	8,171	12,097
	St. Mary	1,630	1,058	1,318	2,086	1,049	3,216	2,006	3,596
District 8 total		26,526	20,041	22,897	37,196	31,504	46,606	42,341	63,040
9	Ascension	5,002	6,403	4,111	4,944	6,877	10,687	9,058	13,013
	Jefferson	2,796	1,916	3,102	5,292	5,572	5,837	3,227	4,334
	Lafourche	3,794	3,017	4,163	4,292	4,720	10,710	8,202	11,361
	Orleans	4,143	2,377	2,096	3,936	3,465	1,422	1,151	784
	Plaquemines	1,009	631	2,517	1,707	2,658	2,661	3,290	3,554
	St. Bernard	293	170	677	1,021	860	2,018	550	969
	St. Charles	478	503	614	1,957	1,411	4,962	3,081	4,361
	St. James	704	433	806	1,517	1,056	1,234	1,528	2,912
	St. John	452	337	374	960	398	1,034	558	848
	Terrebonne	1,403	2,300	2,180	3,870	2,530	5,678	3,435	7,100
District 9 total		20,074	18,087	20,640	29,496	29,547	46,243	34,080	49,236
State total		462,647	429,598	355,433	579,385	545,585	891,099	742,403	1,096,663

Table 9.--Number of farms reporting milk cows, by parishes, 1930-1954

Dist-rict	Parish	Agricultural census year					
		1930	1935	1940	1945	1950	1954
		Number					
1	Bossier	1,968	2,276	1,995	1,506	1,021	1,146
	Caddo	2,840	3,407	2,895	2,576	1,422	1,198
	DeSoto	2,364	2,770	2,891	2,390	1,617	1,488
	Red River	1,449	1,438	1,342	1,035	1,013	655
	Webster	2,072	2,697	2,105	1,768	1,409	1,106
District 1 total		10,693	12,588	11,228	9,275	6,482	5,593
2	Bienville	2,260	2,487	2,374	1,932	1,642	1,207
	Caldwell	695	1,017	995	1,039	792	702
	Claiborne	2,920	3,286	2,727	2,331	1,832	1,427
	Jackson	1,142	1,259	1,329	1,182	807	829
	Lincoln	2,199	2,298	2,180	1,755	1,418	1,106
	Ouachita	1,244	1,540	1,582	1,362	995	872
	Union	2,125	2,739	2,731	2,335	1,446	1,357
	Winn	1,148	1,689	1,397	1,252	969	788
District 2 total		13,733	16,315	15,315	13,188	9,901	8,288
3	E. Carroll	867	1,163	1,390	1,271	935	679
	Franklin	2,544	3,463	3,760	3,427	2,714	2,267
	Madison	633	773	1,006	1,052	768	598
	Morehouse	1,378	1,729	1,756	2,136	1,409	1,051
	Richland	1,927	2,797	2,835	2,541	2,106	1,612
	Tensas	728	940	897	937	671	564
	W. Carroll	1,151	2,024	2,252	2,182	1,779	1,451
District 3 total		9,228	12,889	13,896	13,546	10,382	8,222
4	Natchitoches	2,899	3,471	2,994	2,120	1,994	1,617
	Sabine	1,949	2,483	2,000	1,794	1,562	1,273
	Vernon	903	1,773	1,546	1,812	1,334	1,117
District 4 total		5,751	7,727	6,540	5,726	4,890	4,007
5	Avoyelles	3,142	3,720	3,641	3,895	3,228	3,059
	Catahoula	935	1,212	1,290	1,850	940	884
	Concordia	549	864	988	864	439	450
	Evangeline	3,030	3,704	3,925	3,698	2,844	2,274
	Grant	1,181	1,216	990	1,406	941	875
	LaSalle	641	788	638	600	613	591
	Pt. Coupee	941	915	1,748	2,301	1,043	699
	Rapides	2,209	3,048	2,248	2,617	2,591	2,258
	St. Landry	4,255	4,739	6,203	6,119	5,018	4,545
	W. B. Rouge	164	175	253	293	232	211
District 5 total		17,047	20,381	21,924	23,643	17,889	15,846

(Continued)

Table 9.--Number of farms reporting milk cows, by parishes, 1930-1954--Continued

District	Parish	Agricultural census year					
		1930	1935	1940	1945	1950	1954
		Number					
6	E. B. Rouge	1,202	1,437	1,328	1,619	1,249	796
	E. Feliciana	1,236	1,311	1,058	1,415	1,015	707
	Livingston	1,103	1,460	1,581	1,608	1,573	1,366
	St. Helena	894	953	1,270	1,158	1,068	1,024
	St. Tammany	612	847	838	936	762	640
	Tangipahoa	1,781	2,480	2,496	2,847	2,633	2,280
	Washington	1,737	2,188	2,506	2,532	2,391	2,112
	W. Feliciana	842	663	697	808	415	186
District 6 total		9,407	11,339	11,774	12,923	11,106	9,111
7	Acadia	2,461	3,327	3,347	3,244	2,653	2,343
	Allen	637	968	992	720	854	822
	Beauregard	836	1,109	1,296	1,424	1,083	727
	Calcasieu	918	1,341	1,457	1,382	1,222	704
	Cameron	422	760	732	768	500	374
	Jeff Davis	843	1,223	1,303	1,109	1,160	840
	Vermilion	2,557	3,599	2,958	2,898	2,608	2,053
District 7 total		8,674	12,327	12,085	11,545	10,080	7,863
8	Assumption	282	340	452	313	290	200
	Iberia	873	1,270	1,165	1,161	834	734
	Iberville	286	434	394	492	372	296
	Lafayette	2,529	3,126	2,989	2,941	2,480	2,299
	St. Martin	1,461	2,115	1,971	1,940	1,726	1,736
	St. Mary	372	360	280	313	237	289
District 8 total		5,803	7,645	7,251	7,160	5,939	5,554
9	Ascension	858	862	1,072	1,118	1,039	753
	Jefferson	152	273	197	249	142	110
	Lafourche	808	1,001	837	1,040	756	422
	Orleans	111	196	130	77	37	14
	Plaquemines	106	185	198	243	101	23
	St. Bernard	37	134	54	73	63	34
	St. Charles	112	162	160	269	132	81
	St. James	236	404	236	236	240	196
	St. John	105	198	101	155	97	59
	Terrebonne	419	713	602	612	538	403
District 9 total		2,944	4,128	3,587	4,072	3,145	2,095
State total		83,280	105,339	103,600	101,078	79,814	66,579

Table 10.--Number of milk cows on farms reporting milk production, by parishes, 1910-1954

Dist-rict	Parish	Agricultural census year							
		1910	1920	1930	1935	1940	1945	1950	1954
		Number							
1	Bossier	4,837	3,741	4,320	5,271	5,055	3,341	2,814	3,294
	Caddo	6,768	5,612	7,490	7,992	8,282	6,135	6,522	5,944
	DeSoto	5,692	7,158	6,763	7,035	7,973	6,156	10,402	9,892
	Red River	2,780	3,599	2,516	2,356	2,474	1,699	2,360	1,666
	Webster	4,536	3,625	4,563	5,734	4,895	3,393	4,016	3,145
District 1 total		24,613	23,735	25,652	28,388	28,679	20,724	26,114	23,941
2	Bienville	5,141	6,145	4,139	4,516	4,254	3,511	4,677	4,176
	Caldwell	3,342	2,694	2,124	2,266	2,241	2,048	1,975	1,455
	Claiborne	5,691	8,855	6,975	8,114	6,888	5,833	6,698	5,523
	Jackson	3,008	4,753	2,710	2,757	2,848	2,234	2,048	2,305
	Lincoln	3,897	5,083	5,597	6,347	5,645	4,333	4,313	2,981
	Ouachita	3,342	3,120	3,829	4,000	4,073	3,641	3,240	3,075
	Union	4,466	6,718	4,605	5,768	5,126	4,383	4,270	3,692
	Winn	5,203	3,430	2,655	3,201	2,882	2,218	2,381	1,888
District 2 total		34,090	40,798	32,634	36,969	33,957	28,201	29,602	25,095
3	E. Carroll	763	1,310	1,356	1,726	1,844	1,838	2,229	1,903
	Franklin	3,216	4,686	5,001	6,413	6,843	6,262	8,816	8,099
	Madison	617	1,585	1,300	1,492	1,726	1,757	1,934	2,036
	Morehouse	1,643	3,551	3,427	3,519	3,465	3,546	3,555	2,493
	Richland	1,684	3,438	3,615	4,864	5,195	4,696	5,429	4,822
	Tensas	1,108	1,291	1,344	1,706	1,580	1,674	1,683	1,526
	W. Carroll	3,490	1,403	2,412	3,341	3,667	4,124	4,153	3,615
District 3 total		12,521	17,264	18,455	23,061	24,320	23,897	27,799	24,494

(Continued)

Table 10.--Number of milk cows on farms reporting milk production, by parishes, 1910-1954--Continued

District	Parish	Agricultural census year							
		1910	1920	1930	1935	1940	1945	1950	1954
		Number							
4	Natchitoches	5,410	6,003	6,946	7,101	6,561	4,414	4,627	4,027
	Sabine	5,176	3,185	5,475	5,134	4,686	3,582	5,018	3,413
	Vernon	3,148	991	2,488	3,679	3,373	3,072	2,890	3,117
District 4 total		13,734	10,179	14,909	15,914	14,620	11,068	12,535	10,557
5	Avoyelles	6,579	3,389	6,809	6,266	5,977	5,902	7,924	8,221
	Catahoula	2,706	1,665	2,421	2,608	2,935	3,155	2,155	1,837
	Concordia	1,634	1,081	1,442	1,734	1,926	1,528	1,156	1,100
	Evangeline	---	4,151	8,230	6,671	7,093	5,149	6,253	4,657
	Grant	3,402	1,557	2,750	2,389	2,092	2,113	2,355	2,200
	LaSalle	1,904	590	2,025	1,667	1,469	1,081	1,394	1,053
	Pt. Coupee	2,536	1,648	2,213	1,935	3,020	3,595	2,871	2,460
	Rapides	4,495	3,922	7,816	7,707	6,237	6,302	8,582	8,185
	St. Landry	11,231	4,090	10,226	9,091	12,041	10,546	13,605	13,599
	W. B. Rouge	683	599	478	488	575	601	1,176	838
District 5 total		35,170	22,692	44,410	40,556	43,365	39,972	47,471	44,150
6	E. B. Rouge	2,489	3,154	5,293	5,295	6,629	4,453	6,436	4,270
	E. Feliciana	3,715	5,206	6,063	5,197	4,122	3,964	5,037	4,690
	Livingston	1,804	1,350	2,628	2,600	2,516	2,530	4,149	4,072
	St. Helena	3,054	5,550	3,578	3,161	5,132	6,139	8,109	10,896
	St. Tammany	1,874	980	2,174	1,995	1,938	2,187	3,433	3,866
	Tangipahoa	4,834	7,582	7,300	8,796	11,117	17,398	22,814	32,700
	Washington	5,071	3,912	5,484	5,827	7,818	10,754	14,781	18,920
	W. Feliciana	1,164	1,103	2,078	1,750	1,724	1,732	1,729	1,311
District 6 total		24,005	28,837	34,598	34,621	40,996	49,157	66,488	80,725

(Continued)

Table 10.--Number of milk cows on farms reporting milk production, by parishes, 1910-1954--Continued

District	Parish	1910	1920	1930	1935	1940	1945	1950	1954
		Number							
7	Acadia	6,302	3,219	6,612	8,093	7,028	5,652	6,823	6,539
	Allen	---	901	2,083	2,041	2,060	1,261	1,985	1,829
	Beauregard	---	1,143	2,184	2,444	2,690	2,232	2,958	2,253
	Calcasieu	8,701	1,102	3,287	3,743	4,107	2,438	3,920	2,379
	Cameron	3,450	879	1,267	3,119	2,342	1,860	1,762	830
	Jeff Davis	---	1,087	2,865	2,967	2,954	2,094	2,951	2,163
	Vermilion	3,240	3,615	6,262	8,440	7,116	5,769	9,961	7,502
District 7 total		21,693	11,946	24,560	30,847	28,297	21,306	30,360	23,495
8	Assumption	572	524	766	902	1,455	844	964	603
	Iberia	2,797	2,495	3,175	3,192	3,117	3,632	4,657	5,368
	Iberville	335	1,049	845	1,076	1,224	960	1,645	916
	Lafayette	5,906	3,945	6,109	7,105	6,589	6,354	9,636	10,147
	St. Martin	3,224	2,978	3,389	3,900	3,398	3,766	4,958	4,827
	St. Mary	506	687	1,122	1,019	729	846	909	657
District 8 total		13,340	11,678	15,406	17,194	16,512	16,402	22,769	22,518
9	Ascension	1,454	1,846	2,254	1,738	2,196	2,178	2,987	2,046
	Jefferson	2,166	1,481	2,965	4,304	4,904	4,670	2,541	2,657
	Lafourche	1,340	1,935	1,979	1,783	1,973	2,574	2,065	1,120
	Orleans	3,665	2,310	2,056	2,803	2,494	910	807	638
	Plaquemines	436	282	578	431	573	489	347	105
	St. Bernard	84	89	302	462	491	558	232	268
	St. Charles	---	348	271	715	864	946	840	780
	St. James	444	324	691	808	697	493	697	582
	St. John	122	280	362	678	300	701	330	170
	Terrebonne	390	912	1,347	1,679	1,414	1,206	1,826	1,540
District 9 total		10,101	9,807	12,805	15,401	15,906	14,725	12,672	9,906
State total		189,267	176,936	223,429	242,951	246,652	225,452	275,810	264,881

Table 11.--Number of farms and of cattle, by parishes, 1954

District	Parish	Number of farms		Number of cattle on farms		
		Total	Reporting cattle	All	2 yr. + all cows	Milk cows
1	Bossier	2,020	1,551	38,867	22,981	3,294
	Caddo	2,771	1,748	45,752	26,541	5,944
	DeSoto	2,575	2,204	50,522	31,737	9,892
	Red River	1,551	966	27,591	18,044	1,666
	Webster	1,673	1,424	19,989	11,300	3,145
District 1 total		10,590	7,893	182,721	110,603	23,941
2	Bienville	1,673	1,502	19,311	10,972	4,176
	Caldwell	1,089	941	16,195	8,893	1,455
	Claiborne	2,167	1,754	25,723	14,836	5,523
	Jackson	1,058	960	8,230	4,466	2,305
	Lincoln	1,586	1,370	15,203	8,550	2,981
	Ouachita	1,500	1,157	20,883	11,434	3,075
	Union	2,131	1,806	22,537	12,470	3,692
	Winn	1,134	1,016	12,482	7,000	1,888
District 2 total		12,338	10,506	140,564	78,621	25,095
3	E. Carroll	1,715	814	20,578	11,541	1,903
	Franklin	4,171	2,853	57,404	33,260	8,099
	Madison	1,418	782	29,009	16,190	2,036
	Morehouse	2,610	1,452	30,089	16,875	2,493
	Richland	3,144	2,028	36,801	20,707	4,822
	Tensas	1,341	706	32,604	16,603	1,526
	W. Carroll	2,255	1,731	21,216	11,695	3,615
District 3 total		16,654	10,366	227,701	126,871	24,494
4	Natchitoches	3,169	2,298	57,314	33,806	4,027
	Sabine	1,757	1,658	26,224	15,869	3,413
	Vernon	1,723	1,567	31,330	17,480	3,117
District 4 total		6,649	5,523	114,868	67,155	10,557
5	Avoyelles	4,467	3,557	58,492	33,033	8,221
	Catahoula	1,578	1,199	30,134	17,454	1,837
	Concordia	1,189	650	30,663	16,607	1,100
	Evangeline	3,226	2,651	43,076	26,809	4,657
	Grant	1,322	1,091	17,152	9,772	2,200
	LaSalle	775	719	11,793	6,773	1,053
	Pt. Coupee	1,917	1,182	45,959	27,667	2,460
	Rapides	3,665	2,951	66,578	36,805	8,185
	St. Landry	6,700	5,352	69,543	38,518	13,599
	W. B. Rouge	414	313	9,916	6,316	838
District 5 total		25,253	19,665	383,306	219,754	44,150

(Continued)

Table 11.--Number of farms and of cattle, by parishes, 1954--Continued

District	Parish	Number of farms		Number of cattle on farms		
		Total	Reporting cattle	All	2 yr. + all cows	Milk cows
6	E. B. Rouge	1,704	1,545	34,269	21,416	4,270
	E. Feliciana	1,460	1,152	37,387	22,664	4,690
	Livingston	2,585	2,003	24,460	13,760	4,072
	St. Helena	1,534	1,268	26,484	15,269	10,896
	St. Tammany	1,405	1,096	23,448	13,901	3,866
	Tangipahoa	3,998	2,887	67,266	39,749	32,700
	Washington	2,950	2,632	43,218	24,525	18,920
	W. Feliciana	648	453	22,154	12,857	1,311
District 6 total		16,284	13,036	278,686	164,141	80,725
7	Acadia	3,310	2,835	55,243	32,938	6,539
	Allen	1,160	1,026	22,975	14,786	1,829
	Beauregard	1,262	1,154	26,995	16,728	2,253
	Calcasieu	1,296	1,081	65,349	44,789	2,379
	Cameron	649	592	45,601	28,762	830
	Jeff Davis	1,207	1,098	56,639	38,484	2,163
	Vermilion	2,648	2,406	64,577	40,755	7,502
District 7 total		11,532	10,192	337,379	217,242	23,495
8	Assumption	313	244	2,698	1,799	603
	Iberia	1,002	876	20,202	12,423	5,368
	Iberville	572	428	21,839	12,853	916
	Lafayette	2,928	2,595	33,584	20,272	10,147
	St. Martin	2,198	1,968	19,194	12,097	4,827
	St. Mary	417	381	5,605	3,596	657
District 8 total		7,430	6,492	103,122	63,040	22,518
9	Ascension	1,283	1,155	20,864	13,013	2,046
	Jefferson	218	163	6,905	4,334	2,657
	Lafourche	736	577	19,220	11,361	1,120
	Orleans	40	16	1,051	784	638
	Plaquemines	594	123	5,686	3,554	105
	St. Bernard	153	70	1,665	969	268
	St. Charles	161	128	7,590	4,361	780
	St. James	413	276	4,965	2,912	582
	St. John	141	89	1,321	848	170
	Terrebonne	658	557	12,859	7,100	1,540
District 9 total		4,397	3,154	82,126	49,236	9,906
State total		111,127	86,827	1,850,473	1,096,663	264,881

Table 12.--Number of cattle and/or calves sold alive, by parishes, 1940-1954

District	Parish	Agricultural census year			
		1940	1945	1950	1954
		Number			
1	Bossier	3,765	6,063	4,796	12,857
	Caddo	5,140	8,539	7,959	15,323
	DeSoto	4,980	6,214	11,320	18,420
	Red River	2,574	3,963	5,577	11,166
	Webster	2,826	3,251	3,856	6,219
District 1 total		19,285	28,030	33,508	63,985
2	Bienville	2,115	3,921	3,454	6,235
	Caldwell	973	1,902	2,158	4,107
	Claiborne	2,508	3,232	4,610	8,144
	Jackson	1,282	1,280	918	2,415
	Lincoln	2,343	2,669	2,984	5,333
	Ouachita	2,080	3,718	3,356	7,497
	Union	2,640	3,175	3,530	7,460
	Winn	2,487	3,080	1,956	3,528
District 2 total		16,428	22,977	22,966	44,719
3	E. Carroll	744	4,604	3,490	7,787
	Franklin	3,434	7,571	11,424	17,573
	Madison	1,952	3,353	5,821	10,959
	Morehouse	2,121	5,396	5,819	10,678
	Richland	2,482	3,080	5,102	11,629
	Tensas	3,978	4,339	8,033	11,369
	W. Carroll	1,121	3,068	3,443	5,644
District 3 total		15,832	31,411	43,132	75,639
4	Natchitoches	4,211	5,983	9,785	19,274
	Sabine	3,000	4,760	5,303	9,367
	Vernon	2,929	3,794	4,422	8,090
District 4 total		10,140	14,537	19,510	36,731
5	Avoyelles	3,515	10,452	9,895	16,170
	Catahoula	2,947	3,696	4,488	7,487
	Concordia	2,943	3,452	5,555	9,139
	Evangeline	3,843	5,318	8,167	11,536
	Grant	2,110	3,681	3,999	5,536
	LaSalle	1,274	2,205	1,805	2,691
	Pt. Coupee	5,850	9,343	11,176	14,916
	Rapides	6,634	12,781	15,319	20,443
	St. Landry	6,322	9,065	11,285	19,900
	W. B. Rouge	651	1,799	2,535	3,813
District 5 total		36,089	61,792	74,224	111,631

(Continued)

Table 12.--Number of cattle and/or calves sold alive, by parishes, 1940-1954--Continued

District	Parish	Agricultural census year			
		1940	1945	1950	1954
		Number			
6	E. B. Rouge	7,091	8,191	12,046	11,384
	E. Feliciana	6,961	9,245	10,102	12,032
	Livingston	2,750	3,523	2,892	6,469
	St. Helena	2,760	2,692	4,966	7,135
	St. Tammany	1,881	2,572	3,957	7,933
	Tangipahoa	3,446	5,727	11,737	19,538
	Washington	4,080	6,884	8,711	13,853
	W. Feliciana	3,863	4,485	4,832	7,943
District 6 total		32,832	43,319	59,243	86,287
7	Acadia	5,785	6,274	11,519	15,720
	Allen	3,675	3,670	4,734	7,488
	Beauregard	3,928	4,400	5,164	9,118
	Calcasieu	6,181	6,306	19,377	23,274
	Cameron	5,052	5,896	6,888	11,343
	Jeff Davis	7,925	9,122	14,166	20,435
	Vermilion	6,685	8,409	12,905	20,032
District 7 total		39,231	44,077	74,753	107,410
8	Assumption	209	241	486	860
	Iberia	1,733	2,680	3,256	5,975
	Iberville	2,518	2,452	5,747	9,188
	Lafayette	1,947	3,777	6,071	9,276
	St. Martin	3,806	3,271	3,469	5,785
	St. Mary	277	1,007	885	2,068
District 8 total		10,490	13,428	19,914	33,152
9	Ascension	2,870	5,287	4,867	7,738
	Jefferson	2,235	1,888	2,853	3,284
	Lafourche	2,570	2,987	4,249	6,897
	Orleans	1,860	480	420	466
	Plaquemines	1,219	1,071	1,705	2,323
	St. Bernard	147	1,595	462	815
	St. Charles	472	1,729	1,377	2,722
	St. James	361	397	666	1,815
	St. John	120	268	416	442
	Terrebonne	519	978	1,380	4,083
District 9 total		12,373	16,680	18,395	30,585
State total		192,700	276,251	365,645	590,139

Table 13.--The value in dollars of dairy products sold, by parishes, 1910-1954

District	Parish	1910	1920	1930	1940	1945	1950	1954
		Dollars						
1	Bossier	38,064	43,404	75,240	92,827	114,986	159,869	234,043
	Caddo	76,172	99,427	305,961	398,288	537,391	687,074	570,855
	DeSoto	28,933	55,750	206,942	180,827	467,659	1,296,213	1,325,215
	Red River	3,303	1,039	4,622	6,152	13,093	33,243	65,156
	Webster	15,256	8,744	92,376	56,835	92,361	167,114	200,661
District 1 total		161,728	208,364	685,141	734,929	1,225,990	2,343,513	2,395,930
2	Bienville	9,298	14,796	36,069	26,269	36,315	115,338	355,684
	Caldwell	1,666	8,164	15,122	12,140	14,624	10,426	5,302
	Claiborne	7,165	32,267	94,835	91,172	260,137	368,450	509,183
	Jackson	8,579	12,748	35,432	33,814	74,282	54,343	93,517
	Lincoln	28,097	30,839	132,188	115,428	131,706	181,570	142,458
	Ouachita	15,020	65,332	199,108	178,173	330,678	248,266	263,751
	Union	9,396	19,803	47,016	28,066	23,303	70,528	155,679
	Winn	10,735	26,940	26,163	15,312	34,388	53,268	52,935
District 2 total		89,956	210,889	585,933	500,374	905,433	1,102,189	1,578,509
3	E. Carroll	2,518	3,619	6,943	2,269	20,396	85,602	98,804
	Franklin	2,011	4,159	21,891	22,794	30,753	306,705	382,395
	Madison	2,100	7,878	30,181	35,233	46,943	85,244	202,304
	Morehouse	2,682	17,801	31,264	16,383	71,127	107,563	126,564
	Richland	4,075	10,116	32,053	19,653	41,471	87,060	172,652
	Tensas	2,395	1,725	16,680	9,301	9,848	19,631	64,992
	W. Carroll	2,148	1,538	6,017	14,514	23,712	59,756	107,103
District 3 total		17,929	46,836	145,029	120,147	244,250	751,561	1,154,814

(Continued)

Table 13.--The value in dollars of dairy products sold, by parishes, 1910-1954--Continued

Dist-rict	Parish	Agricultural census year						
		1910	1920	1930	1940	1945	1950	1954
		Dollars						
4	Natchitoches	10,800	24,607	46,819	83,612	89,892	74,211	123,232
	Sabine	8,241	10,197	25,154	23,997	24,918	218,917	218,357
	Vernon	12,942	6,799	16,750	13,456	76,450	117,745	377,654
District 4 total		31,983	41,603	88,723	121,065	191,260	410,873	719,243
5	Avoyelles	3,602	7,157	37,054	15,073	102,932	187,337	334,115
	Catahoula	2,636	1,334	6,959	9,298	17,258	21,430	12,092
	Concordia	491	5,501	8,440	10,739	27,735	12,031	31,710
	Evangeline	---	1,787	7,131	14,640	6,740	44,427	135,915
	Grant	7,963	3,331	25,162	8,770	40,064	51,450	64,624
	LaSalle	5,052	11,364	19,983	26,835	17,589	38,628	20,082
	Pt. Coupee	1,006	6,819	12,482	15,007	11,095	151,101	225,870
	Rapides	19,160	79,433	289,306	250,047	472,330	729,582	764,877
	St. Landry	15,304	10,364	68,369	75,145	98,549	364,270	343,103
	W. B. Rouge	3,154	586	16,345	25,519	12,971	96,826	68,620
District 5 total		58,368	127,676	491,231	451,073	807,263	1,697,082	2,001,008
6	E. B. Rouge	9,059	134,323	307,321	464,090	497,695	798,810	577,778
	E. Feliciana	13,001	121,222	341,427	163,721	362,478	659,185	676,257
	Livingston	2,583	3,407	5,785	7,086	42,135	167,819	217,168
	St. Helena	5,229	119,503	161,366	173,375	713,268	1,108,797	1,628,446
	St. Tammany	25,858	22,003	68,508	101,482	164,439	292,130	461,135
	Tangipahoa	144,920	455,486	473,892	586,229	2,300,364	3,592,753	6,146,950
	Washington	3,934	83,872	128,959	232,000	943,227	1,908,669	2,752,645
	W. Feliciana	2,915	10,235	19,938	32,866	104,421	215,720	215,804
District 6 total		207,499	950,051	1,507,196	1,760,849	5,128,027	8,743,883	12,676,183

(Continued)

Table 13.--The value in dollars of dairy products sold, by parishes, 1910-1954--Continued

District	Parish	Agricultural census year						
		1910	1920	1930	1940	1945	1950	1954
		Dollars						
7	Acadia	9,031	13,080	70,060	59,285	114,599	282,025	251,106
	Allen	---	14,922	26,033	32,115	89,251	138,858	149,646
	Beauregard	---	21,889	50,338	62,714	69,964	222,925	264,944
	Calcasieu	53,720	35,718	173,597	146,243	144,103	310,742	245,922
	Cameron	167	1,594	5,482	7,702	9,566	21,113	6,436
	Jeff Davis	---	6,639	52,826	56,666	84,248	79,782	89,080
	Vermilion	17,330	30,776	27,938	38,391	119,397	471,880	531,790
District 7 total		80,248	124,618	406,274	403,116	631,128	1,527,325	1,538,924
8	Assumption	4,338	1,023	17,177	38,682	4,971	22,801	22,219
	Iberia	23,934	37,342	123,871	118,571	415,303	657,428	725,251
	Iberville	7,970	11,170	43,243	58,515	44,945	146,651	49,844
	Lafayette	17,980	17,084	92,872	134,054	344,953	541,371	878,611
	St. Martin	3,702	8,079	33,190	23,638	79,376	196,376	270,581
	St. Mary	13,301	24,911	55,421	38,866	40,979	1,161	10,175
District 8 total		71,225	99,609	365,774	412,326	930,527	1,565,788	1,956,681
9	Ascension	452	8,941	18,465	37,144	73,131	119,187	127,252
	Jefferson	254,719	374,991	513,678	805,588	1,251,895	835,744	609,198
	Lafourche	4,907	12,449	31,182	57,437	104,096	25,189	25,534
	Orleans	595,815	468,033	373,772	431,259	215,035	216,319	199,000
	Plaquemines	329	1,256	53,788	44,580	28,989	26,375	10,000
	St. Bernard	2,301	1,569	29,008	64,796	141,396	22,410	31,995
	St. Charles	15	2,940	4,273	94,555	149,700	218,028	187,158
	St. James	2,670	202	18,349	16,829	9,155	12,885	1,398
	St. John	514	1,374	44,791	13,851	68,371	21,057	---
	Terrebonne	7,680	32,990	49,256	55,382	109,992	63,343	116,761
District 9 total		869,402	904,745	1,136,562	1,621,421	2,151,760	1,560,537	1,308,296
State total		1,588,338	2,714,391	5,411,863	6,125,300	12,215,638	19,702,751	25,329,588

Table 14.--The value in dollars of whole milk sold, by parishes, 1930, 1950, and 1954

Dist-rict	Parish	Agricultural census year 1930	1950	1954
		Dollars		
1	Bossier	69,417	145,019	233,289
	Caddo	287,216	671,383	570,652
	DeSoto	197,082	1,293,719	1,324,701
	Red River	2,515	30,832	65,020
	Webster	60,184	158,291	198,115
District 1 total		616,414	2,299,244	2,391,777
2	Bienville	19,187	107,543	354,270
	Caldwell	5,861	9,209	4,016
	Claiborne	34,996	358,541	499,170
	Jackson	17,734	48,559	92,346
	Lincoln	57,968	167,427	140,787
	Ouachita	177,258	237,807	261,367
	Union	8,675	59,963	152,656
	Winn	17,939	51,256	52,629
District 2 total		339,618	1,040,305	1,557,241
3	E. Carroll	5,810	81,155	95,470
	Franklin	13,301	302,902	381,001
	Madison	26,757	83,392	202,039
	Morehouse	22,726	105,939	126,335
	Richland	18,302	81,135	171,102
	Tensas	15,843	18,449	64,889
	W. Carroll	1,852	56,256	106,220
District 3 total		104,591	729,228	1,147,056
4	Natchitoches	36,083	73,157	122,958
	Sabine	17,134	214,012	217,883
	Vernon	12,687	116,556	377,603
District 4 total		65,904	403,725	718,444
5	Avoyelles	27,856	187,128	334,115
	Catahoula	4,824	20,502	12,092
	Concordia	7,342	11,941	31,636
	Evangeline	5,320	44,213	135,890
	Grant	15,945	51,347	43,988
	LaSalle	13,796	37,986	20,082
	Pt. Coupee	11,020	150,677	225,870
	Rapides	264,447	728,262	764,197
	St. Landry	55,877	363,315	342,853
	W. B. Rouge	14,453	96,826	68,620
District 5 total		420,880	1,692,197	1,979,343

(Continued)

Table 14.--The value in dollars of whole milk sold, by parishes, 1930, 1950, and 1954--Continued

District	Parish	Agricultural census year		
		1930	1950	1954
		Dollars		
6	E. B. Rouge	290,398	798,029	577,646
	E. Feliciana	333,943	658,692	676,257
	Livingston	4,568	167,321	217,035
	St. Helena	156,866	1,108,028	1,628,431
	St. Tammany	61,220	289,061	461,135
	Tangipahoa	466,595	3,584,067	6,145,170
	Washington	117,679	1,899,879	2,751,553
	W. Feliciana	15,295	215,520	215,804
District 6 total		1,446,564	8,720,597	12,673,031
7	Acadia	54,849	274,431	250,837
	Allen	22,939	138,297	149,484
	Beauregard	42,246	215,943	264,883
	Calcasieu	159,819	308,978	245,922
	Cameron	962	20,903	6,436
	Jeff Davis	37,043	78,940	88,180
	Vermilion	24,630	467,593	531,735
District 7 total		342,488	1,505,085	1,537,477
8	Assumption	13,511	22,801	22,219
	Iberia	91,110	657,070	723,265
	Iberville	42,623	145,827	49,844
	Lafayette	81,761	538,547	861,111
	St. Martin	27,101	196,327	270,581
	St. Mary	44,319	825	10,175
District 8 total		300,425	1,561,397	1,937,195
9	Ascension	16,473	118,931	127,252
	Jefferson	512,163	824,744	598,198
	Lafourche	30,513	25,099	25,534
	Orleans	373,508	216,319	199,000
	Plaquemines	53,634	26,360	10,000
	St. Bernard	29,008	22,410	31,995
	St. Charles	3,668	217,928	187,158
	St. James	14,266	12,885	1,398
	St. John	44,758	21,057	---
	Terrebonne	48,601	63,243	116,761
District 9 total		1,126,592	1,548,976	1,297,296
State total		4,763,476	19,500,754	25,238,860

Table 15.--The value in dollars of hogs, by parishes, 1910-1950

District	Parish	1910	1920	1930	1940	1945	1950
		Dollars					
1	Bossier	104,473	222,386	107,599	79,408	136,326	131,270
	Caddo	114,358	201,518	143,052	73,065	110,241	111,679
	DeSoto	94,897	236,415	104,905	51,613	115,077	58,880
	Red River	48,914	104,445	68,364	27,672	55,902	62,377
	Webster	68,154	132,418	78,599	44,581	83,289	70,373
District 1 total		430,796	897,182	502,519	276,339	500,835	434,579
2	Bienville	94,467	177,665	72,193	49,376	100,849	100,784
	Caldwell	44,709	110,641	167,864	75,619	199,320	240,335
	Claiborne	76,858	205,087	91,199	44,529	108,522	122,836
	Jackson	36,735	117,547	56,909	35,934	90,117	76,652
	Lincoln	54,644	89,870	46,915	29,901	60,906	71,174
	Ouachita	83,602	155,643	99,985	44,315	125,362	137,917
	Union	80,814	171,664	109,879	72,221	170,582	151,261
	Winn	77,925	235,315	193,209	90,006	269,124	201,579
District 2 total		549,754	1,263,432	838,153	441,901	1,124,782	1,102,538
3	E. Carroll	44,054	130,499	61,821	45,033	74,007	133,573
	Franklin	60,564	242,433	135,108	109,483	157,010	208,135
	Madison	42,269	109,792	58,744	37,570	90,450	122,272
	Morehouse	93,201	197,445	105,090	68,160	217,017	216,055
	Richland	81,033	172,449	93,184	65,958	79,834	157,497
	Tensas	79,222	90,515	56,210	38,178	124,164	174,988
	W. Carroll	47,693	80,841	77,978	70,343	124,128	157,858
District 3 total		448,036	1,023,974	588,135	434,725	866,610	1,170,378

(Continued)

Table 15.--The value in dollars of hogs, by parishes, 1910-1950--Continued

Dist-: rict	Parish	Agricultural census year 1910	1920	1930	1940	1945	1950
		- - - - - - - - - -	- - - - - - - - - -	- - - - - - - - - -	Dollars - - - - - - - - - -	- - - - - - - - - -	- - - - - - - - - -
4	Natchitoches	141,727	254,889	229,057	119,239	189,320	163,641
	Sabine	102,555	172,255	205,943	82,234	175,580	86,507
	Vernon	65,442	76,438	170,738	81,390	248,871	172,644
District 4 total		309,824	503,582	605,738	282,863	613,771	422,792
5	Avoyelles	149,697	218,489	213,458	156,731	428,400	324,002
	Catahoula	69,473	123,253	286,475	139,878	243,708	259,693
	Concordia	100,317	135,026	139,635	86,038	109,050	130,088
	Evangeline	---	185,801	210,976	122,320	278,069	231,257
	Grant	55,335	131,518	96,988	54,078	181,921	144,344
	LaSalle	36,807	81,248	135,790	54,994	149,011	166,928
	Pt. Coupee	76,797	168,051	117,811	64,808	206,826	136,184
	Rapides	145,088	260,100	244,634	135,047	416,142	412,907
	St. Landry	308,771	257,961	316,209	234,202	611,044	616,541
	W. B. Rouge	29,822	31,837	11,871	9,417	25,657	19,004
District 5 total		972,107	1,593,284	1,773,847	1,057,513	2,649,828	2,440,948
6	E. B. Rouge	73,781	132,075	69,409	27,262	80,130	52,589
	E. Feliciana	71,960	105,502	81,904	25,337	87,152	68,627
	Livingston	46,931	122,262	77,869	81,737	251,671	139,649
	St. Helena	26,246	94,412	25,534	17,656	49,639	30,547
	St. Tammany	26,035	83,551	88,958	37,286	151,460	105,574
	Tangipahoa	38,559	114,183	37,544	27,310	74,873	58,951
	Washington	55,576	158,242	168,603	103,027	273,518	196,124
	W. Feliciana	46,262	101,031	59,066	30,270	89,338	55,136
District 6 total		385,350	911,258	608,887	349,885	1,057,781	707,197

(Continued)

Table 15.--The value in dollars of hogs, by parishes, 1910-1950--Continued

District	Parish	1910	1920	1930	1940	1945	1950
		Dollars					
7	Acadia	88,468	171,171	137,858	78,797	180,696	159,949
	Allen	---	76,094	82,197	58,517	108,362	125,112
	Beauregard	---	63,134	118,697	61,211	158,103	157,816
	Calcasieu	170,927	64,007	82,403	38,259	76,509	54,139
	Cameron	15,512	34,831	25,277	18,248	30,852	16,381
	Jeff Davis	---	79,420	71,179	25,229	43,820	42,639
	Vermilion	84,482	152,319	148,575	79,868	172,202	152,317
District 7 total		359,389	640,976	666,186	360,129	770,544	708,353
8	Assumption	14,572	17,059	15,434	11,786	17,652	19,463
	Iberia	42,634	123,276	82,122	28,029	78,200	70,435
	Iberville	20,234	43,175	35,681	16,492	30,675	39,549
	Lafayette	102,635	152,574	115,021	69,832	184,316	217,783
	St. Martin	70,649	91,404	95,244	61,628	112,696	180,698
	St. Mary	21,527	37,159	41,952	7,036	27,854	27,302
District 8 total		272,251	464,647	385,454	194,803	451,393	555,230
9	Ascension	31,079	76,493	29,155	19,560	44,226	32,690
	Jefferson	2,730	12,116	9,483	7,482	12,362	10,263
	Lafourche	18,460	60,026	42,056	22,266	58,370	36,556
	Orleans	15,017	5,115	2,614	3,375	14,900	11,073
	Plaquemines	1,785	11,986	3,747	4,548	6,924	13,091
	St. Bernard	551	1,596	2,441	9,888	15,048	19,323
	St. Charles	5,597	21,197	5,622	6,528	12,794	22,486
	St. James	7,177	8,777	9,055	6,882	7,656	12,152
	St. John	3,744	8,498	7,648	4,134	15,968	7,211
	Terrebonne	10,399	37,304	22,946	15,153	34,508	24,562
District 9 total		96,539	243,108	134,767	99,816	222,756	189,407
State total		3,824,046	7,541,443	6,103,686	3,497,974	8,258,300	7,731,422

Table 16.--Number of farms reporting hogs (of all ages) on farms, by parishes, 1930-1954

District	Parish	Agricultural census year					
		1930	1935	1940	1945	1950	1954
		Number					
1	Bossier	2,158	3,080	2,363	1,377	1,326	1,038
	Caddo	4,479	4,569	3,550	2,239	2,067	1,257
	DeSoto	2,705	3,391	3,042	2,187	1,401	1,226
	Red River	1,700	1,847	1,460	933	1,028	568
	Webster	2,172	2,730	2,007	1,488	1,308	864
District 1 total		13,214	15,617	12,422	8,224	7,130	4,953
2	Bienville	1,914	2,520	2,363	1,617	1,374	823
	Caldwell	756	1,090	1,017	1,009	896	699
	Claiborne	2,912	3,561	2,775	2,229	1,799	1,211
	Jackson	965	1,216	1,188	1,080	650	505
	Lincoln	1,714	2,002	1,909	1,326	1,086	749
	Ouachita	1,350	1,638	1,489	1,022	925	589
	Union	1,913	2,485	2,646	2,201	1,254	1,008
	Winn	1,174	1,522	1,395	1,208	1,045	636
District 2 total		12,698	16,034	14,782	11,692	9,029	6,220
3	E. Carroll	1,886	2,018	2,139	1,421	1,417	793
	Franklin	2,702	4,091	4,389	2,609	2,739	1,579
	Madison	1,134	1,496	1,805	1,584	1,124	815
	Morehouse	1,633	2,768	2,603	1,942	1,873	1,141
	Richland	2,210	3,346	3,390	1,572	2,126	1,389
	Tensas	911	1,820	1,617	1,463	1,127	734
	W. Carroll	1,244	2,338	2,580	1,947	1,650	1,141
District 3 total		11,720	17,877	18,523	12,538	12,056	7,592
4	Natchitoches	3,313	4,309	3,396	2,182	2,282	1,521
	Sabine	1,672	2,419	1,956	1,424	1,081	735
	Vernon	1,165	1,876	1,623	1,617	1,529	747
District 4 total		6,150	8,604	6,975	5,223	4,892	3,003
5	Avoyelles	3,728	4,253	4,114	3,883	3,288	2,572
	Catahoula	1,163	1,481	1,674	1,759	1,084	924
	Concordia	750	1,306	1,146	901	775	593
	Evangeline	3,637	4,179	4,062	3,541	3,111	1,901
	Grant	1,148	1,521	1,079	1,229	1,023	664
	LaSalle	606	704	570	560	659	520
	Pt. Coupee	1,832	1,895	2,281	2,544	1,506	1,001
	Rapides	2,485	3,618	2,489	2,401	2,557	1,877
	St. Landry	5,657	6,370	6,989	6,432	6,202	4,816
	W. B. Rouge	259	339	352	320	203	171
District 5 total		21,265	25,666	24,756	23,570	20,408	15,039

(Continued)

Table 16.--Number of farms reporting hogs (of all ages) on farms, by parishes, 1930-1954--Continued

District	Parish	Agricultural census year					
		1930	1935	1940	1945	1950	1954
		Dollars					
6	E. B. Rouge	1,358	1,732	1,095	1,094	767	335
	E. Feliciana	1,783	1,947	1,531	1,643	1,170	888
	Livingston	762	1,660	1,344	1,423	1,175	871
	St. Helena	824	1,027	1,068	1,070	910	682
	St. Tammany	758	1,022	867	918	935	635
	Tangipahoa	936	1,750	1,584	2,094	1,500	1,040
	Washington	1,820	2,496	2,690	2,438	2,047	1,268
	W. Feliciana	1,073	1,173	1,042	983	599	407
District 6 total		9,314	12,807	11,221	11,663	9,103	6,126
7	Acadia	2,762	3,251	3,026	2,911	2,373	1,835
	Allen	845	1,088	1,057	714	952	689
	Beauregard	932	1,140	1,185	1,087	1,082	561
	Calcasieu	991	1,148	1,117	1,001	864	442
	Cameron	397	532	532	532	318	176
	Jeff Davis	1,220	1,353	1,081	835	795	446
	Vermilion	2,882	3,273	2,795	2,514	2,115	1,358
District 7 total		10,029	11,785	10,793	9,594	8,499	5,507
8	Assumption	228	238	336	249	223	114
	Iberia	1,016	1,065	1,006	1,020	686	524
	Iberville	428	618	471	402	375	231
	Lafayette	2,707	3,076	2,867	2,717	2,338	1,799
	St. Martin	1,739	1,951	2,018	1,755	1,791	1,460
	St. Mary	364	249	208	279	220	211
District 8 total		6,482	7,197	6,906	6,422	5,633	4,339
9	Ascension	595	706	829	889	627	357
	Jefferson	35	47	66	59	63	28
	Lafourche	641	622	695	853	570	278
	Orleans	5	14	21	36	32	2
	Plaquemines	22	14	111	152	67	42
	St. Bernard	24	43	22	42	30	15
	St. Charles	76	161	160	164	93	45
	St. James	158	360	217	116	162	184
	St. John	83	202	113	153	99	68
	Terrebonne	360	449	481	405	328	156
District 9 total		1,999	2,618	2,715	2,869	2,071	1,175
State total		92,871	118,205	109,093	91,795	78,821	53,954

Table 17.—Number of hogs and pigs on farms, by parishes, 1910-1954

District	Parish	Agricultural census year							
		1910	1920	1930	1935	1940	1945	1950	1954
		Number							
1	Bossier	31,579	25,108	13,674	16,547	16,736	12,962	11,004	6,557
	Caddo	27,996	17,035	18,521	17,634	15,035	10,481	9,676	6,470
	DeSoto	30,830	22,507	13,786	14,620	10,648	10,437	5,306	3,825
	Red River	19,001	16,390	7,955	7,345	5,854	5,186	5,677	2,677
	Webster	24,286	14,167	10,142	12,390	9,409	7,793	6,505	4,160
District 1 total		133,692	95,207	64,078	68,536	57,682	46,859	38,168	23,689
2	Bienville	33,172	23,980	8,960	10,513	10,628	9,828	7,612	4,069
	Caldwell	23,721	17,213	19,295	17,381	16,111	19,599	15,972	9,137
	Claiborne	20,254	16,815	11,231	15,016	9,676	10,540	8,797	4,912
	Jackson	15,208	15,489	6,337	8,109	7,568	9,111	5,247	3,094
	Lincoln	12,280	7,712	5,599	7,315	6,491	6,078	5,190	3,077
	Ouachita	26,285	16,940	12,434	10,506	9,350	11,756	9,699	4,564
	Union	31,264	23,396	12,575	17,317	15,333	16,327	11,112	8,376
	Winn	40,654	30,382	22,093	22,059	17,977	28,488	13,843	7,387
District 2 total		202,838	151,927	98,524	108,216	93,134	111,727	77,472	44,616
3	E. Carroll	9,864	8,661	8,009	8,830	10,060	7,294	10,184	5,530
	Franklin	29,800	30,426	16,282	23,748	24,142	16,855	16,957	7,971
	Madison	11,184	10,991	7,293	9,104	8,225	9,192	9,397	6,481
	Morehouse	31,004	24,206	15,168	24,976	13,650	21,700	17,392	8,701
	Richland	29,496	17,670	11,160	17,573	14,540	8,698	13,039	8,555
	Tensas	21,088	9,907	6,796	11,074	8,365	11,832	13,182	6,543
	W. Carroll	15,874	10,716	9,522	17,878	15,073	12,455	12,914	8,256
District 3 total		148,310	112,577	74,230	113,183	94,055	88,026	93,065	52,037

(Continued)

Table 17.--Number of hogs and pigs on farms, by parishes, 1910-1954--Continued

District	Parish	1910	1920	1930	1935	1940	1945	1950	1954
		Number							
4	Natchitoches	57,528	34,886	28,263	29,094	24,125	19,551	17,059	10,055
	Sabine	45,906	27,045	24,689	22,425	17,784	16,640	8,422	5,051
	Vernon	39,420	13,383	19,198	23,156	17,260	23,819	16,513	8,206
District 4 total		142,854	75,314	72,150	74,675	59,169	60,010	41,994	23,312
5	Avoyelles	44,100	22,773	28,990	29,923	28,630	39,800	29,094	23,872
	Catahoula	30,716	16,410	33,394	30,264	27,569	26,938	19,438	17,009
	Concordia	23,055	15,322	18,145	22,567	15,901	9,890	10,200	7,763
	Evangeline	---	22,253	29,329	22,143	23,584	28,094	20,820	11,763
	Grant	26,445	15,277	11,824	14,710	10,731	17,566	11,586	6,902
	LaSalle	18,953	12,892	14,882	12,130	11,066	16,128	12,243	8,865
	Pt. Coupee	23,444	17,219	16,578	9,368	11,947	19,954	11,425	8,698
	Rapides	57,247	27,452	29,851	32,419	26,389	38,568	33,857	24,694
	St. Landry	102,686	27,076	41,565	36,403	44,099	56,116	56,426	44,735
	W. B. Rouge	4,883	2,705	1,485	1,433	1,814	2,293	1,460	1,133
District 5 total		331,529	179,379	226,043	211,360	201,730	255,347	206,549	155,434
6	E. B. Rouge	20,885	10,617	8,495	7,817	5,038	7,491	3,984	2,419
	E. Feliciana	20,226	10,692	10,218	8,926	4,660	8,598	5,152	3,787
	Livingston	27,005	18,682	8,008	16,909	14,610	22,675	11,050	5,845
	St. Helena	11,062	9,336	3,034	3,504	3,173	4,701	2,387	1,853
	St. Tammany	13,378	9,357	10,765	8,752	6,752	12,527	8,427	5,509
	Tangipahoa	15,581	11,282	4,671	6,030	4,949	7,277	4,692	2,823
	Washington	27,039	19,363	20,401	20,944	18,485	26,892	15,489	7,307
	W. Feliciana	13,805	10,517	8,357	7,324	5,423	8,542	4,362	3,907
District 6 total		148,981	99,846	73,949	80,206	63,090	98,703	55,543	33,450

(Continued)

Table 17.--Number of hogs and pigs on farms, by parishes, 1910-1954--Continued

District	Parish	Agricultural census year							
		1910	1920	1930	1935	1940	1945	1950	1954
		Number							
7	Acadia	29,083	17,045	18,136	19,000	13,065	18,967	14,376	10,267
	Allen	---	8,473	9,576	9,148	9,840	10,584	10,845	6,044
	Beauregard	---	7,177	13,213	12,426	10,414	14,760	12,883	6,649
	Calcasieu	66,484	6,186	10,634	7,067	6,542	7,199	4,408	2,785
	Cameron	5,600	4,827	3,489	2,644	3,044	2,933	1,581	1,179
	Jeff Davis	---	6,241	9,893	8,096	4,305	4,695	3,696	2,034
	Vermilion	23,225	16,716	21,587	17,444	12,953	18,344	14,003	6,794
District 7 total		124,392	66,665	86,528	75,825	60,163	77,482	61,792	35,752
8	Assumption	2,545	1,927	1,769	1,131	2,232	1,855	1,242	519
	Iberia	12,625	11,182	10,414	4,930	5,364	7,549	5,176	3,324
	Iberville	4,356	4,259	3,974	3,215	3,127	2,741	2,611	1,727
	Lafayette	30,628	16,701	15,668	16,012	12,951	18,082	17,124	11,032
	St. Martin	19,010	9,837	11,962	7,152	11,146	11,297	13,637	7,615
	St. Mary	4,664	3,418	4,895	1,581	1,309	2,375	1,820	1,178
District 8 total		73,828	47,324	48,682	34,021	36,129	43,899	41,610	25,395
9	Ascension	6,815	6,860	3,205	2,289	3,106	3,759	2,295	1,517
	Jefferson	518	948	1,081	237	1,152	1,091	689	353
	Lafourche	4,923	6,086	4,745	2,174	3,547	5,213	2,423	1,659
	Orleans	1,991	334	242	238	551	1,382	682	150
	Plaquemines	539	1,106	380	57	707	552	772	696
	St. Bernard	125	172	234	914	1,610	1,230	1,032	126
	St. Charles	995	1,435	617	772	1,018	1,007	1,365	503
	St. James	1,731	900	1,075	1,167	1,067	672	810	775
	St. John	970	794	906	899	639	1,382	481	764
	Terrebonne	2,574	3,688	2,743	1,788	2,323	2,804	1,605	716
District 9 total		21,181	22,323	15,228	10,535	15,720	19,092	12,154	7,259
State total		1,327,605	850,562	759,412	776,557	680,872	801,145	628,347	400,944

Table 18.--Number of hogs on farms, by parishes, 1910-1954

District	Parish	Agricultural census year							
		1910	1920	1930	1935	1940	1945	1950	1954
		Number							
1	Bossier	31,579	25,108	13,674	16,547	16,736	12,962	11,004	6,557
	Caddo	27,996	17,035	18,521	17,634	15,035	10,481	9,676	6,470
	DeSoto	30,830	22,507	13,786	14,620	10,648	10,437	5,306	3,825
	Red River	19,001	16,390	7,955	7,345	5,854	5,186	5,677	2,677
	Webster	24,286	14,167	10,142	12,390	9,409	7,793	6,505	4,160
District 1 total		133,692	95,207	64,078	68,536	57,682	46,859	38,168	23,689
2	Bienville	33,172	23,980	8,960	10,513	10,628	9,828	7,612	4,069
	Caldwell	23,721	17,213	19,295	17,381	16,111	19,599	15,972	9,137
	Claiborne	20,254	16,815	11,231	15,016	9,676	10,540	8,797	4,912
	Jackson	15,208	15,489	6,337	8,109	7,568	9,111	5,247	3,094
	Lincoln	12,280	7,712	5,599	7,315	6,491	6,078	5,190	3,077
	Ouachita	26,285	16,940	12,434	10,506	9,350	11,756	9,699	4,564
	Union	31,264	23,396	12,575	17,317	15,333	16,327	11,112	8,376
	Winn	40,654	30,382	22,093	22,059	17,977	28,488	13,843	7,387
District 2 total		202,838	151,927	98,524	108,216	93,134	111,727	77,472	44,616
3	E. Carroll	9,864	8,661	8,009	8,830	10,060	7,294	10,184	5,530
	Franklin	29,800	30,426	16,282	23,748	24,142	16,855	16,957	7,971
	Madison	11,184	10,991	7,293	9,104	8,225	9,192	9,397	6,481
	Morehouse	31,004	24,206	15,168	24,976	13,650	21,700	17,392	8,701
	Richland	29,496	17,670	11,160	17,573	14,540	8,698	13,039	8,555
	Tensas	21,088	9,907	6,796	11,074	8,365	11,832	13,182	6,543
	W. Carroll	15,874	10,716	9,522	17,878	15,073	12,455	12,914	8,256
District 3 total		148,310	112,577	74,230	113,183	94,055	88,026	93,065	52,037

(Continued)

Table 18.--Number of hogs on farms, by parishes, 1910-1954--Continued

Dist-rict	Parish	Agricultural census year 1910	1920	1930	1935	1940	1945	1950	1954
		Number							
4	Natchitoches	57,528	34,886	28,263	29,094	24,125	19,551	17,059	10,055
	Sabine	45,906	27,045	24,689	22,425	17,784	16,640	8,422	5,051
	Vernon	39,420	13,383	19,198	23,156	17,260	23,819	16,513	8,206
District 4 total		142,854	75,314	72,150	74,675	59,169	60,010	41,994	23,312
5	Avoyelles	44,100	22,773	28,990	29,923	28,630	39,800	29,094	23,872
	Catahoula	30,716	16,410	33,394	30,264	27,569	26,938	19,438	17,009
	Concordia	23,055	15,322	13,145	22,567	15,901	9,890	10,200	7,763
	Evangeline	---	22,253	29,329	22,143	23,584	28,094	20,820	11,763
	Grant	26,445	15,277	11,824	14,710	10,731	17,566	11,586	6,902
	LaSalle	18,953	12,892	14,882	12,130	11,066	16,128	12,243	8,865
	Pt. Coupee	23,444	17,219	16,578	9,368	11,947	19,954	11,425	8,698
	Rapides	57,247	27,452	29,851	32,419	26,389	38,568	33,857	24,694
	St. Landry	102,686	27,076	41,565	36,403	44,099	56,116	56,426	44,735
	W. B. Rouge	4,883	2,705	1,485	1,433	1,814	2,293	1,460	1,133
District 5 total		331,529	179,379	226,043	211,360	201,730	255,347	206,549	155,434
6	E. B. Rouge	20,885	10,617	8,495	7,817	5,038	7,491	3,984	2,419
	E. Feliciana	20,226	10,692	10,218	8,926	4,660	8,598	5,152	3,787
	Livingston	27,005	18,682	8,008	16,909	14,610	22,675	11,050	5,845
	St. Helena	11,062	9,336	3,034	3,504	3,173	4,701	2,387	1,853
	St. Tammany	13,378	9,357	10,765	8,752	6,752	12,527	8,427	5,509
	Tangipahoa	15,581	11,282	4,671	6,030	4,949	7,277	4,692	2,823
	Washington	27,039	19,363	20,401	20,944	18,485	26,892	15,489	7,307
	W. Feliciana	13,805	10,517	8,357	7,324	5,423	8,542	4,362	3,907
District 6 total		148,981	99,846	73,949	80,206	63,090	98,703	55,543	33,450

(Continued)

Table 18.--Number of hogs on farms, by parishes, 1910-1954--Continued

District	Parish	Agricultural census year							
		1910	1920	1930	1935	1940	1945	1950	1954
		Number							
7	Acadia	29,083	17,045	18,136	19,000	13,065	18,967	14,376	10,267
	Allen	---	8,473	9,576	9,148	9,840	10,584	10,845	6,044
	Beauregard	---	7,177	13,213	12,426	10,414	14,760	12,883	6,649
	Calcasieu	66,484	6,186	10,634	7,067	6,542	7,199	4,408	2,785
	Cameron	5,600	4,827	3,489	2,644	3,044	2,933	1,581	1,179
	Jeff Davis	---	6,241	9,893	8,096	4,305	4,695	3,696	2,034
	Vermilion	23,225	16,716	21,587	17,444	12,953	18,344	14,003	6,794
District 7 total		124,392	66,665	86,528	75,825	60,163	77,482	61,792	35,752
8	Assumption	2,545	1,927	1,769	1,131	2,232	1,855	1,242	519
	Iberia	12,625	11,182	10,414	4,930	5,364	7,549	5,176	3,324
	Iberville	4,356	4,259	3,974	3,215	3,127	2,741	2,611	1,727
	Lafayette	30,628	16,701	15,668	16,012	12,951	18,082	17,124	11,032
	St. Martin	19,010	9,837	11,962	7,152	11,146	11,297	13,637	7,615
	St. Mary	4,664	3,418	4,895	1,581	1,309	2,375	1,820	1,178
District 8 total		73,828	47,324	48,682	34,021	36,129	43,899	41,610	25,395
9	Ascension	6,815	6,860	3,205	2,289	3,106	3,759	2,295	1,517
	Jefferson	518	948	1,081	237	1,152	1,091	689	353
	Lafourche	4,923	6,086	4,745	2,174	3,547	5,213	2,423	1,659
	Orleans	1,991	334	242	238	551	1,382	682	150
	Plaquemines	539	1,106	380	57	707	552	772	696
	St. Bernard	125	172	234	914	1,610	1,230	1,032	126
	St. Charles	995	1,435	617	772	1,018	1,007	1,365	503
	St. James	1,731	900	1,075	1,167	1,067	672	810	775
	St. John	970	794	906	899	639	1,382	481	764
	Terrebonne	2,574	3,688	2,743	1,788	2,323	2,804	1,605	716
District 9 total		21,181	22,323	15,228	10,535	15,720	19,092	12,154	7,259
State total		1,327,605	850,562	759,412	776,557	680,872	801,145	628,347	400,944

Table 19.--Number of hogs four months old and over, by parishes, 1930-1954

District	Parish	Agricultural census year			
		1930	1940	1950	1954
		Number			
1	Bossier	8,755	16,736	7,005	3,736
	Caddo	11,187	15,035	5,743	3,378
	DeSoto	7,367	10,648	2,887	2,514
	Red River	5,236	5,854	3,020	1,329
	Webster	6,197	9,409	3,338	2,403
District 1 total		38,742	57,682	21,993	13,360
2	Bienville	5,543	10,628	3,732	2,132
	Caldwell	13,583	16,111	10,385	5,995
	Claiborne	7,652	9,676	4,876	2,964
	Jackson	4,737	7,568	3,208	1,693
	Lincoln	3,507	6,491	2,762	1,865
	Ouachita	7,339	9,350	5,596	2,331
	Union	9,394	15,333	5,814	4,898
	Winn	15,718	17,977	8,406	5,318
District 2 total		67,473	93,134	44,779	27,196
3	E. Carroll	5,632	10,060	5,940	3,017
	Franklin	10,888	24,142	8,593	3,924
	Madison	4,999	8,225	5,392	3,484
	Morehouse	8,542	13,650	9,048	4,704
	Richland	7,871	14,540	6,376	4,332
	Tensas	4,506	8,365	7,879	3,747
	W. Carroll	7,303	15,073	6,485	3,825
District 3 total		49,741	94,055	49,713	27,033
4	Natchitoches	17,773	24,125	9,871	6,177
	Sabine	16,359	17,784	5,702	3,120
	Vernon	13,522	17,260	11,619	4,425
District 4 total		47,654	59,169	27,192	13,722
5	Avoyelles	16,261	28,630	12,974	11,511
	Catahoula	23,768	27,569	13,218	9,346
	Concordia	11,023	15,901	6,285	3,929
	Evangeline	15,659	23,584	9,221	6,183
	Grant	7,888	10,731	6,779	3,949
	LaSalle	11,749	11,066	8,679	5,830
	Pt. Coupee	8,571	11,947	6,037	4,563
	Rapides	19,955	26,389	18,873	14,996
	St. Landry	24,230	44,099	23,916	25,411
	W. B. Rouge	954	1,814	940	625
District 5 total		140,058	201,730	106,922	86,343

(Continued)

Table 19.—Number of hogs four months old and over, by parishes, 1930-1954—Continued

Dist-rict	Parish	Agricultural census year			
		1930	1940	1950	1954
		Number			
6	E. B. Rouge	5,331	5,038	2,408	1,292
	E. Feliciana	5,961	4,660	3,182	2,238
	Livingston	6,669	14,610	5,996	3,269
	St. Helena	2,038	3,173	1,337	842
	St. Tammany	6,846	6,752	4,471	3,043
	Tangipahoa	2,697	4,949	2,508	1,662
	Washington	13,256	18,485	8,446	3,974
	W. Feliciana	3,660	5,423	2,368	1,614
District 6 total		46,458	63,090	30,716	17,934
7	Acadia	10,310	13,065	6,708	4,690
	Allen	6,312	9,840	5,519	3,678
	Beauregard	9,064	10,414	7,504	4,010
	Calcasieu	6,276	6,542	2,582	1,646
	Cameron	1,830	3,044	613	645
	Jeff Davis	5,286	4,305	1,881	1,053
	Vermilion	9,799	12,953	6,175	3,158
District 7 total		48,877	60,163	30,982	18,880
8	Assumption	1,197	2,232	874	360
	Iberia	6,053	5,364	2,663	1,840
	Iberville	2,801	3,127	1,712	1,072
	Lafayette	7,582	12,951	7,412	5,143
	St. Martin	7,045	11,146	6,569	2,857
	St. Mary	3,272	1,309	1,169	556
District 8 total		27,950	36,129	20,399	11,828
9	Ascension	2,134	3,106	1,291	876
	Jefferson	664	1,152	428	277
	Lafourche	3,052	3,547	1,547	880
	Orleans	219	551	506	90
	Plaquemines	286	707	623	460
	St. Bernard	195	1,610	997	104
	St. Charles	427	1,018	1,042	369
	St. James	651	1,067	511	458
	St. John	541	639	303	428
	Terrebonne	1,644	2,323	1,056	449
District 9 total		9,813	15,720	8,304	4,391
State total		476,766	680,872	341,000	220,687

Table 20.—Number of hogs less than four months old, by parishes, 1930, 1950 and 1954

Dist-rict	Parish	Agricultural census year 1930	1950	1954
		- - - - - - - - - -	Number	- - - - - - - - - -
1	Bossier	4,919	3,999	2,821
	Caddo	7,334	3,933	3,092
	DeSoto	6,419	2,419	1,311
	Red River	2,719	2,657	1,348
	Webster	3,945	3,167	1,757
District 1 total		25,336	16,175	10,329
2	Bienville	3,417	3,880	1,937
	Caldwell	5,712	5,587	3,142
	Claiborne	3,579	3,921	1,948
	Jackson	1,600	2,039	1,401
	Lincoln	2,092	2,428	1,212
	Ouachita	5,095	4,103	2,233
	Union	3,181	5,298	3,478
	Winn	6,375	5,437	2,069
District 2 total		31,051	32,693	17,420
3	E. Carroll	2,377	4,244	2,513
	Franklin	5,394	8,364	4,047
	Madison	2,294	4,005	2,997
	Morehouse	6,626	8,344	3,997
	Richland	3,289	6,663	4,223
	Tensas	2,290	5,303	2,796
	W. Carroll	2,219	6,429	4,431
District 3 total		24,489	43,352	25,004
4	Natchitoches	10,490	7,188	3,878
	Sabine	8,330	2,720	1,931
	Vernon	5,676	4,894	3,781
District 4 total		24,496	14,802	9,590
5	Avoyelles	12,729	16,120	12,361
	Catahoula	9,626	6,220	7,663
	Concordia	7,122	3,915	3,834
	Evangeline	13,670	11,599	5,580
	Grant	3,936	4,807	2,953
	LaSalle	3,133	3,564	3,035
	Pt. Coupee	8,007	5,388	4,135
	Rapides	9,896	14,984	9,698
	St. Landry	17,335	32,510	19,324
	W. B. Rouge	531	520	508
District 5 total		85,985	99,627	69,091

(Continued)

Table 20.--Number of hogs less than four months old, by parishes, 1930, 1950 and 1954--Continued

District	Parish	Agricultural census year		
		1930	1950	1954
		Number		
6	E. B. Rouge	3,164	1,576	1,127
	E. Feliciana	4,257	1,970	1,549
	Livingston	1,339	5,054	2,576
	St. Helena	996	1,050	1,011
	St. Tammany	3,919	3,956	2,466
	Tangipahoa	1,974	2,184	1,161
	Washington	7,145	7,043	3,333
	W. Feliciana	4,697	1,994	2,293
District 6 total		27,491	24,827	15,516
7	Acadia	7,826	7,668	5,577
	Allen	3,264	5,326	2,366
	Beauregard	4,149	5,379	2,639
	Calcasieu	4,358	1,826	1,139
	Cameron	1,659	968	534
	Jeff Davis	4,607	1,815	981
	Vermilion	11,788	7,828	3,636
District 7 total		37,651	30,810	16,872
8	Assumption	572	368	159
	Iberia	4,361	2,513	1,484
	Iberville	1,173	899	655
	Lafayette	8,086	9,712	5,889
	St. Martin	4,917	7,068	4,758
	St. Mary	1,623	651	622
District 8 total		20,732	21,211	13,567
9	Ascension	1,071	1,004	641
	Jefferson	417	261	76
	Lafourche	1,693	876	779
	Orleans	23	176	60
	Plaquemines	94	149	236
	St. Bernard	39	35	22
	St. Charles	190	323	134
	St. James	424	299	317
	St. John	365	178	336
	Terrebonne	1,099	549	267
District 9 total		5,415	3,850	2,868
State total		282,646	287,347	180,257

Table 21.--The value in dollars of all sheep and lambs, by parishes, 1910-1950

Dist-rict	Parish	Agricultural census year					
		1910	1920	1930	1940	1945	1950
		Dollars					
1	Bossier	3,923	5,587	1,575	937	930	4,160
	Caddo	1,096	1,367	732	1,283	1,830	3,080
	DeSoto	5,105	5,714	1,721	2,647	2,156	4,335
	Red River	1,008	550	126	108	9	88
	Webster	2,974	1,664	1,398	746	586	1,295
District 1 total		14,106	14,882	5,552	5,721	5,511	12,958
2	Bienville	1,792	2,164	833	81	339	606
	Caldwell	2,006	1,083	1,631	326	1,130	755
	Claiborne	1,250	2,663	844	101	235	339
	Jackson	698	809	125	36	84	---
	Lincoln	471	563	469	95	266	372
	Ouachita	1,548	4,235	1,240	148	414	1,504
	Union	670	1,258	403	166	183	98
	Winn	2,589	1,973	910	340	398	235
District 2 total		11,024	14,748	6,455	1,293	3,049	3,909
3	E. Carroll	3,334	3,383	496	368	126	4,204
	Franklin	2,353	6,195	2,677	1,055	1,492	2,962
	Madison	745	6,744	1,473	2,740	1,992	36,221
	Morehouse	2,277	5,922	914	288	834	1,832
	Richland	5,086	6,999	2,845	1,325	1,212	4,438
	Tensas	4,276	11,576	5,061	3,300	7,472	8,083
	W. Carroll	1,217	1,495	224	496	1,430	2,974
District 3 total		19,288	42,314	13,690	9,572	14,558	60,714
4	Natchitoches	6,844	12,909	8,267	7,264	5,115	4,877
	Sabine	4,136	3,394	2,466	1,610	2,477	466
	Vernon	26,175	17,666	26,335	40,976	37,848	17,693
District 4 total		37,155	33,969	37,068	49,850	45,440	23,036
5	Avoyelles	3,188	2,892	2,420	952	2,661	9,927
	Catahoula	1,645	1,952	1,237	344	1,848	1,611
	Concordia	1,722	691	1,042	1,832	144	247
	Evangeline	---	23,818	6,596	15,996	11,257	5,887
	Grant	1,652	3,727	3,715	286	1,840	893
	LaSalle	1,305	842	325	390	543	492
	Pt. Coupee	2,117	7,902	5,162	1,420	1,526	3,885
	Rapides	16,074	28,908	19,574	13,134	22,608	18,270
	St. Landry	16,744	10,372	7,058	3,964	6,481	7,049
	W. B. Rouge	415	1,335	7,687	131	703	4,793
District 5 total		44,862	82,439	54,816	38,449	49,611	53,054

(Continued)

Table 21.--The value in dollars of all sheep and lambs, by parishes, 1910-1950--Continued

Dist-rict	Parish	Agricultural census year					
		1910	1920	1930	1940	1945	1950
		Dollars					
6	E. B. Rouge	5,718	13,400	6,527	1,543	1,299	1,748
	E. Feliciana	3,956	7,767	5,917	727	1,587	1,412
	Livingston	3,671	8,599	1,848	2,871	7,431	624
	St. Helena	1,167	7,181	130	493	684	6
	St. Tammany	13,177	72,392	36,025	27,510	56,854	3,353
	Tangipahoa	12,776	29,556	7,571	8,783	9,077	3,396
	Washington	14,071	30,743	14,490	6,412	6,188	1,533
	W. Feliciana	2,323	5,063	2,900	1,342	1,135	1,199
District 6 total		56,859	174,701	75,408	49,681	84,255	13,271
7	Acadia	3,708	9,914	5,330	7,438	14,913	25,391
	Allen	---	36,052	45,434	37,087	36,906	54,705
	Beauregard	---	182,465	325,582	232,746	367,117	222,221
	Calcasieu	134,035	31,006	45,321	69,386	71,491	56,679
	Cameron	2,973	4,440	4,344	9,550	13,850	12,738
	Jeff Davis	---	12,720	15,050	14,718	16,366	24,222
	Vermilion	3,970	8,661	10,430	13,117	19,973	33,295
District 7 total		144,686	285,258	451,491	384,042	540,616	429,251
8	Assumption	1,717	301	979	250	112	5,581
	Iberia	1,639	3,045	3,285	973	1,323	2,559
	Iberville	416	3,278	2,944	1,103	1,337	2,913
	Lafayette	2,866	4,757	2,653	1,522	3,622	4,944
	St. Martin	1,710	2,330	2,774	1,871	1,661	3,610
	St. Mary	1,009	1,145	644	117	606	471
District 8 total		9,357	14,856	13,279	5,836	8,661	20,078
9	Ascension	3,481	5,736	2,035	989	1,348	13,612
	Jefferson	147	60	292	137	1,270	1,171
	Lafourche	227	1,213	1,424	437	1,286	2,282
	Orleans	56	20	---	304	13	113
	Plaquemines	129	40	---	---	444	193
	St. Bernard	204	68	59	59	627	14
	St. Charles	714	1,084	156	124	496	82
	St. James	383	333	276	235	13	6,544
	St. John	58	100	199	109	97	4,301
	Terrebonne	310	338	435	40	---	869
District 9 total		5,709	8,992	4,876	2,434	5,594	29,181
State total		343,046	672,159	662,635	546,878	757,295	645,452

Table 22.--Number of farms reporting sheep and/or lambs on farms, by parishes, 1930-1954

District	Parish	Agricultural census year					
		1930	1935	1940	1945	1950	1954
		Number					
1	Bossier	21	19	18	8	12	26
	Caddo	20	22	31	25	28	45
	DeSoto	27	28	36	15	18	40
	Red River	9	6	4	1	1	10
	Webster	18	14	13	10	10	22
District 1 total		95	89	102	59	69	143
2	Bienville	22	9	5	3	8	14
	Caldwell	14	11	5	8	2	6
	Claiborne	10	9	5	1	5	8
	Jackson	4	---	3	3	---	1
	Lincoln	16	9	7	6	4	10
	Ouachita	14	4	5	7	11	10
	Union	22	11	6	2	2	3
	Winn	12	8	6	3	2	4
District 2 total		114	61	42	33	34	56
3	E. Carroll	11	9	7	2	6	6
	Franklin	36	46	22	22	19	36
	Madison	4	12	15	14	8	26
	Morehouse	12	14	11	10	12	11
	Richland	32	40	22	11	11	24
	Tensas	32	33	26	30	26	30
	W. Carroll	5	9	8	6	6	11
District 3 total		132	163	111	95	88	144
4	Natchitoches	64	57	74	33	32	31
	Sabine	29	18	22	13	8	9
	Vernon	70	132	159	85	40	23
District 4 total		163	207	255	131	80	63
5	Avoyelles	45	72	31	44	45	76
	Catahoula	16	23	11	11	6	12
	Concordia	17	14	6	3	2	10
	Evangeline	74	91	119	39	97	133
	Grant	17	16	11	10	9	5
	LaSalle	6	6	7	4	2	4
	Pt. Coupee	87	52	46	33	27	22
	Rapides	106	145	110	122	69	89
	St. Landry	150	149	115	118	148	196
	W. B. Rouge	16	4	4	2	5	4
District 5 total		534	572	460	386	410	551

(Continued)

Table 22.—Number of farms reporting sheep and/or lambs on farms, by parishes, 1930-1954—Continued

Dist-: rict :	Parish	Agricultural census year					
		1930	1935	1940	1945	1950	1954
		- - - - - -	- - - - - -	- - -	Number	- - - - - -	- - - - - -
6	E. B. Rouge	83	45	28	23	26	21
	E. Feliciana	60	39	16	21	18	8
	Livingston	34	76	48	44	17	34
	St. Helena	6	6	4	3	1	1
	St. Tammany	107	109	115	97	38	68
	Tangipahoa	47	78	59	27	30	39
	Washington	74	78	37	22	11	22
	W. Feliciana	31	24	24	13	8	11
District 6 total		442	455	331	250	149	204
7	Acadia	102	241	242	264	337	449
	Allen	177	182	184	84	86	115
	Beauregard	214	233	196	181	131	117
	Calcasieu	105	160	188	187	155	143
	Cameron	49	148	157	106	95	83
	Jeff Davis	182	226	262	220	259	214
	Vermilion	238	410	466	359	510	423
District 7 total		1,067	1,600	1,695	1,401	1,573	1,544
8	Assumption	8	10	8	2	6	3
	Iberia	42	80	59	36	37	35
	Iberville	21	17	6	5	10	11
	Lafayette	99	200	69	95	101	130
	St. Martin	74	104	63	17	47	37
	St. Mary	10	11	6	17	12	3
District 8 total		254	422	211	172	213	219
9	Ascension	60	88	47	31	35	25
	Jefferson	3	---	2	10	7	4
	Lafourche	10	5	13	5	11	3
	Orleans	---	2	2	1	2	---
	Plaquemines	---	1	---	8	3	4
	St. Bernard	3	6	1	4	1	3
	St. Charles	5	13	7	6	2	5
	St. James	9	19	8	1	6	5
	St. John	9	18	7	6	6	6
	Terrebonne	6	9	5	---	9	4
District 9 total		105	161	92	72	82	59
State total		2,906	3,730	3,299	2,599	2,698	2,983

Table 23.--Number of sheep and lambs on farms, by parishes, 1910-1954

District	Parish	Agricultural census year							
		1910	1920	1930	1935	1940	1945	1950	1954
		Number							
1	Bossier	2,353	1,050	384	343	306	202	670	2,781
	Caddo	539	326	176	283	445	399	492	1,293
	DeSoto	2,597	1,152	420	662	871	479	689	601
	Red River	664	146	33	41	40	2	14	427
	Webster	2,181	418	341	276	258	127	208	225
District 1 total		8,334	3,092	1,354	1,605	1,920	1,209	2,073	5,327
2	Bienville	1,196	682	218	92	32	74	75	240
	Caldwell	1,322	388	415	269	119	249	94	121
	Claiborne	979	768	219	189	39	50	42	96
	Jackson	733	227	30	---	14	18	---	3
	Lincoln	315	100	122	64	39	60	47	73
	Ouachita	898	632	309	90	54	90	184	179
	Union	568	270	103	60	63	39	12	13
	Winn	2,077	609	223	164	111	87	29	39
District 2 total		8,088	3,676	1,639	928	471	667	483	764
3	E. Carroll	1,075	537	132	247	116	27	460	620
	Franklin	1,452	1,152	686	907	337	323	320	768
	Madison	278	1,002	376	3,469	866	426	3,729	904
	Morehouse	1,246	1,086	234	381	94	179	195	363
	Richland	2,457	1,324	719	987	421	263	464	860
	Tensas	1,459	1,364	1,321	1,765	1,040	1,615	873	1,353
	W. Carroll	490	287	55	33	158	309	324	1,241
District 3 total		8,457	6,752	3,523	7,789	3,032	3,142	6,365	6,109

(Continued)

Table 23.--Number of sheep and lambs on farms, by parishes, 1910-1954--Continued

District	Parish	Agricultural census year							
		1910	1920	1930	1935	1940	1945	1950	1954
		Number							
4	Natchitoches	3,984	2,779	2,044	2,466	2,300	1,145	955	1,885
	Sabine	2,681	775	626	324	505	556	93	164
	Vernon	12,753	3,507	6,723	12,104	13,162	8,495	3,533	2,012
District 4 total		19,418	7,061	9,393	14,894	15,967	10,196	4,581	4,061
5	Avoyelles	1,643	567	634	746	336	609	1,635	2,381
	Catahoula	841	379	330	489	119	425	262	582
	Concordia	648	129	264	295	637	33	40	699
	Evangeline	---	4,746	1,678	4,198	5,512	2,568	947	1,187
	Grant	1,371	866	898	226	100	417	149	151
	LaSalle	871	279	82	63	141	121	80	139
	Pt. Coupee	1,003	1,623	1,352	432	490	352	636	1,126
	Rapides	9,989	5,769	5,074	6,140	4,552	5,173	3,020	4,123
	St. Landry	10,239	2,239	1,906	1,712	1,375	1,484	1,148	1,519
	W. B. Rouge	155	358	2,198	20	45	158	823	871
District 5 total		26,760	16,955	14,416	14,321	13,307	11,340	8,740	12,778
6	E. B. Rouge	2,364	2,118	1,778	559	533	302	310	319
	E. Feliciana	1,808	1,462	1,613	686	255	369	254	125
	Livingston	2,710	1,837	481	1,707	985	1,728	105	480
	St. Helena	921	1,409	34	109	174	159	1	1
	St. Tammany	6,540	12,038	8,844	11,599	9,594	13,222	594	1,507
	Tangipahoa	6,939	6,467	1,861	3,396	3,036	2,111	593	2,576
	Washington	7,714	5,374	3,721	4,321	2,225	1,439	262	689
	W. Feliciana	990	898	760	398	455	264	219	409
District 6 total		29,986	31,603	19,092	22,775	17,257	19,594	2,338	6,106

(Continued)

Table 23.--Number of sheep and lambs on farms, by parishes, 1910-1954--Continued

District	Parish	Agricultural census year							
		1910	1920	1930	1935	1940	1945	1950	1954
		Number							
7	Acadia	2,525	2,374	1,349	2,755	2,577	3,358	3,527	4,404
	Allen	---	7,982	11,788	10,141	12,890	8,263	7,368	9,838
	Beauregard	---	34,663	84,892	104,942	82,186	82,332	29,944	26,370
	Calcasieu	63,432	5,669	11,266	26,072	24,247	16,042	7,650	14,750
	Cameron	2,106	951	1,069	2,117	3,317	3,092	1,761	2,027
	Jeff Davis	---	2,321	3,919	3,694	5,154	3,668	3,418	2,967
	Vermilion	2,751	1,860	2,842	4,516	4,529	4,474	4,651	4,463
District 7 total		70,814	55,820	117,125	154,237	134,900	121,229	58,319	64,819
8	Assumption	417	63	259	90	99	27	911	514
	Iberia	824	674	893	714	390	320	388	894
	Iberville	150	644	826	457	427	322	477	296
	Lafayette	1,478	1,012	698	1,298	602	872	773	857
	St. Martin	963	457	749	846	734	402	574	275
	St. Mary	294	212	163	391	48	147	73	24
District 8 total		4,126	3,062	3,588	3,796	2,300	2,090	3,196	2,860
9	Ascension	1,555	1,171	546	639	351	317	2,085	1,950
	Jefferson	56	6	76	---	49	299	176	130
	Lafourche	88	299	370	136	157	302	369	537
	Orleans	22	3	---	5	108	3	18	---
	Plaquemines	43	4	---	3	---	104	28	31
	St. Bernard	63	8	17	116	21	147	2	12
	St. Charles	177	161	44	385	44	117	11	540
	St. James	169	26	87	188	83	3	963	1,013
	St. John	22	27	52	108	40	23	652	2,972
	Terrebonne	109	60	110	34	15	---	120	9
District 9 total		2,304	1,795	1,302	1,614	868	1,315	4,424	7,194
State total		178,287	129,816	171,432	221,959	190,022	170,782	90,519	110,018

Table 24.--Number of ewes, one year old and over, by parishes, 1920-1954

District	Parish	1920	1930	1935	1940	1945	1950	1954
		Number						
1	Bossier	700	195	213	267	137	379	2,080
	Caddo	233	91	202	276	248	252	802
	DeSoto	756	232	464	739	160	326	371
	Red River	68	10	20	18	---	5	401
	Webster	287	159	188	168	90	117	120
District 1 total		2,044	687	1,087	1,468	635	1,079	3,774
2	Bienville	421	102	47	25	44	36	151
	Caldwell	249	218	145	114	116	42	28
	Claiborne	465	119	129	29	50	20	49
	Jackson	134	17	---	11	15	---	---
	Lincoln	64	42	45	14	9	41	30
	Ouachita	454	198	48	48	62	98	117
	Union	184	25	23	56	39	5	8
	Winn	362	128	88	86	52	13	25
District 2 total		2,333	849	525	383	387	255	408
3	E. Carroll	398	69	197	102	22	217	486
	Franklin	750	315	647	262	188	178	442
	Madison	643	201	2,045	758	371	2,066	482
	Morehouse	626	133	269	55	141	89	245
	Richland	902	334	787	361	138	177	584
	Tensas	824	539	1,124	911	1,018	489	798
	W. Carroll	142	30	19	133	197	154	874
District 3 total		4,285	1,621	5,088	2,582	2,075	3,370	3,911
4	Natchitoches	1,686	1,082	1,373	1,770	767	485	871
	Sabine	553	304	160	444	305	51	82
	Vernon	2,134	3,372	7,135	8,782	4,697	2,285	1,396
District 4 total		4,373	4,758	8,668	10,996	5,769	2,821	2,349
5	Avoyelles	361	297	398	181	397	914	1,472
	Catahoula	248	139	223	98	321	116	344
	Concordia	76	157	222	526	25	20	484
	Evangeline	2,745	917	2,598	4,764	1,499	458	611
	Grant	514	616	140	60	186	81	106
	LaSalle	164	42	46	65	10	45	41
	Pt. Coupee	957	669	168	384	290	363	764
	Rapides	4,516	2,589	3,780	3,778	3,353	1,731	2,350
	St. Landry	1,510	853	1,031	965	986	560	870
	W. B. Rouge	220	1,113	1	36	40	59	607
District 5 total		11,311	7,392	8,607	10,857	7,107	4,347	7,649

(Continued)

Table 24.—Number of ewes, one year old and over, by parishes, 1920-1954—Continued

District	Parish	Agricultural census year						
		1920	1930	1935	1940	1945	1950	1954
		Number						
6	E. B. Rouge	1,555	777	346	454	169	155	205
	E. Feliciana	1,045	736	484	168	276	137	84
	Livingston	982	256	1,099	852	1,376	61	258
	St. Helena	841	22	64	91	100	---	---
	St. Tammany	8,353	5,954	7,028	6,931	8,648	314	960
	Tangipahoa	3,163	1,383	1,447	2,604	1,618	334	1,239
	Washington	3,090	1,628	2,278	1,726	819	118	471
	W. Feliciana	643	359	281	395	157	113	327
District 6 total		19,672	11,115	13,027	13,221	13,163	1,232	3,544
7	Acadia	1,214	790	1,758	1,859	1,369	1,769	2,780
	Allen	4,470	6,380	6,426	9,984	5,487	4,705	6,373
	Beauregard	22,185	45,321	67,860	52,442	48,561	16,033	15,840
	Calcasieu	3,204	7,538	16,669	18,355	9,064	3,975	8,629
	Cameron	614	729	1,511	2,631	2,445	1,000	1,293
	Jeff Davis	1,561	2,368	2,219	3,604	2,267	1,954	1,873
	Vermilion	1,071	1,236	2,896	3,675	2,874	2,428	2,960
District 7 total		34,319	64,362	99,339	92,550	72,067	31,864	39,748
8	Assumption	44	138	66	66	18	712	358
	Iberia	451	417	395	213	215	155	599
	Iberville	442	391	197	384	150	235	153
	Lafayette	664	294	746	429	406	336	570
	St. Martin	305	277	519	602	270	308	167
	St. Mary	118	91	268	17	111	38	15
District 8 total		2,024	1,608	2,191	1,711	1,170	1,784	1,862
9	Ascension	863	260	397	293	171	1,005	1,253
	Jefferson	5	54	---	38	140	105	87
	Lafourche	231	113	88	117	174	156	256
	Orleans	---	---	---	100	3	7	---
	Plaquemines	---	---	---	---	78	16	16
	St. Bernard	7	4	67	20	93	2	8
	St. Charles	104	21	255	32	46	7	418
	St. James	27	20	41	68	3	543	604
	St. John	15	21	54	25	---	364	2,083
	Terrebonne	45	54	20	10	---	95	7
District 9 total		1,297	547	922	703	708	2,300	4,732
State total		81,658	92,939	139,454	134,471	103,081	49,052	67,977

Table 25.—Number of lambs under one year of age, on farms, by parishes, 1910-1954

District	Parish	Agricultural census year					
		1910	1920	1930	1940	1950	1954
		- - - - - - - - - - - - Number - - - - - - - - - - - -					
1	Bossier	613	198	99	18	251	584
	Caddo	135	51	46	31	191	325
	DeSoto	633	254	120	36	278	163
	Red River	128	51	13	4	7	5
	Webster	424	84	96	13	76	77
District 1 total		1,933	638	374	102	803	1,154
2	Bienville	284	133	85	5	28	69
	Caldwell	273	90	128	5	44	20
	Claiborne	312	205	83	5	16	44
	Jackson	192	24	4	3	---	3
	Lincoln	90	13	43	7	6	33
	Ouachita	160	103	80	5	39	25
	Union	122	49	28	6	5	---
	Winn	380	96	42	6	12	1
District 2 total		1,813	713	493	42	150	195
3	E. Carroll	367	96	60	7	233	122
	Franklin	403	289	219	22	120	229
	Madison	65	301	120	15	593	154
	Morehouse	280	259	79	11	78	77
	Richland	602	313	197	22	179	244
	Tensas	527	459	487	26	323	358
	W. Carroll	97	73	10	8	157	260
District 3 total		2,341	1,790	1,172	111	1,683	1,444
4	Natchitoches	812	585	368	74	211	754
	Sabine	507	104	157	22	25	65
	Vernon	3,107	474	1,584	159	747	357
District 4 total		4,426	1,163	2,109	255	983	1,176
5	Avoyelles	388	139	183	31	519	763
	Catahoula	222	108	124	11	101	212
	Concordia	142	27	68	6	13	181
	Evangeline	---	979	346	119	300	413
	Grant	325	204	119	11	55	43
	LaSalle	155	78	19	7	22	59
	Pt. Coupee	197	338	394	46	184	282
	Rapides	1,746	438	1,360	110	951	1,001
	St. Landry	1,984	420	620	115	401	425
	W. B. Rouge	51	96	1,006	4	721	210
District 5 total		5,210	2,827	4,239	460	3,267	3,589

(Continued)

Table 25.--Number of lambs under one year of age, on farms, by parishes, 1910-1954--Continued

District	Parish	Agricultural census year					
		1910	1920	1930	1940	1950	1954
		Number					
6	E. B. Rouge	696	344	612	28	102	72
	E. Feliciana	504	323	562	16	94	26
	Livingston	680	312	123	48	8	97
	St. Helena	184	174	10	4	---	1
	St. Tammany	1,147	2,176	1,246	115	186	329
	Tangipahoa	1,371	623	289	59	142	803
	Washington	1,318	764	770	37	52	170
	W. Feliciana	301	149	200	24	96	68
District 6 total		6,201	4,865	3,812	331	680	1,566
7	Acadia	575	621	271	242	1,243	1,220
	Allen	---	1,532	2,963	184	1,633	2,650
	Beauregard	---	5,292	22,111	196	8,121	6,278
	Calcasieu	13,816	1,066	1,919	188	2,159	4,385
	Cameron	612	233	158	157	548	555
	Jeff Davis	---	398	1,057	262	1,205	792
	Vermilion	584	521	975	466	1,650	1,103
District 7 total		15,587	9,663	29,454	1,695	16,559	16,983
8	Assumption	199	12	76	8	171	75
	Iberia	238	134	307	59	130	183
	Iberville	19	134	341	9	197	127
	Lafayette	184	143	184	69	285	176
	St. Martin	271	108	234	60	186	72
	St. Mary	42	59	32	6	21	9
District 8 total		953	590	1,174	211	990	642
9	Ascension	337	167	173	47	804	524
	Jefferson	11	1	22	2	53	40
	Lafourche	12	23	78	13	185	175
	Orleans	6	3	---	2	9	---
	Plaquemines	3	---	---	---	7	10
	St. Bernard	33	---	8	1	---	2
	St. Charles	35	53	18	7	1	103
	St. James	56	17	53	8	269	204
	St. John	2	9	12	7	217	551
	Terrebonne	20	---	20	5	7	2
District 9 total		515	273	384	92	1,552	1,611
State total		38,979	22,522	43,211	3,299	26,667	28,360

Table 26.--Number of rams and wethers on farms, by parishes, 1930, 1950, and 1954

District	Parish	Agricultural census year		
		1930	1950	1954
		Number		
1	Bossier	37	40	117
	Caddo	10	49	166
	DeSoto	50	85	67
	Red River	4	2	21
	Webster	53	15	28
District 1 total		154	191	399
2	Bienville	11	11	20
	Caldwell	29	8	73
	Claiborne	9	6	3
	Jackson	5	---	---
	Lincoln	25	---	10
	Ouachita	9	47	37
	Union	19	2	5
	Winn	20	4	13
District 2 total		127	78	161
3	E. Carroll	1	10	12
	Franklin	61	22	97
	Madison	13	1,070	268
	Morehouse	13	28	41
	Richland	71	108	32
	Tensas	86	61	197
	W. Carroll	6	13	107
District 3 total		251	1,312	754
4	Natchitoches	232	259	260
	Sabine	53	17	17
	Vernon	929	501	259
District 4 total		1,214	777	536
5	Avoyelles	42	202	146
	Catahoula	16	45	26
	Concordia	16	7	34
	Evangeline	198	189	163
	Grant	96	13	2
	LaSalle	9	13	39
	Pt. Coupee	117	89	80
	Rapides	452	338	772
	St. Landry	213	187	224
	W. B. Rouge	56	43	54
District 5 total		1,215	1,126	1,540

(Continued)

Table 26.--Number of rams and weathers on farms, by parishes, 1930, 1950, and 1954—Continued

District	Parish	Agricultural census year 1930	1950	1954
		Number		
6	E. B. Rouge	118	53	42
	E. Feliciana	94	23	15
	Livingston	33	36	125
	St. Helena	2	1	---
	St. Tammany	970	94	218
	Tangipahoa	145	117	534
	Washington	1,017	92	48
	W. Feliciana	91	10	14
District 6 total		2,470	426	996
7	Acadia	105	515	404
	Allen	873	1,030	815
	Beauregard	9,226	5,790	4,252
	Calcasieu	1,107	1,516	1,736
	Cameron	122	213	179
	Jeff Davis	182	259	302
	Vermilion	313	573	400
District 7 total		11,928	9,896	8,088
8	Assumption	4	28	81
	Iberia	54	103	112
	Iberville	35	45	16
	Lafayette	109	152	111
	St. Martin	104	80	36
	St. Mary	9	14	---
District 8 total		315	422	356
9	Ascension	40	276	173
	Jefferson	---	18	3
	Lafourche	133	28	106
	Orleans	---	2	---
	Plaquemines	---	5	5
	St. Bernard	5	---	2
	St. Charles	3	3	19
	St. James	6	151	205
	St. John	14	71	338
	Terrebonne	22	18	---
District 9 total		223	572	851
State total		17,897	14,800	13,681

Table 27.—The value in dollars of wool shorn, by parishes, 1910, 1920, 1930, and 1950

District	Parish	Agricultural census year			
		1910	1920	1930	1950
		Dollars			
1	Bossier	792	1,166	337	582
	Caddo	201	549	89	378
	DeSoto	850	1,480	295	600
	Red River	175	65	5	---
	Webster	591	264	267	261
District 1 total		2,609	3,524	993	1,821
2	Bienville	374	651	121	67
	Caldwell	279	280	304	56
	Claiborne	246	494	161	253
	Jackson	276	200	14	---
	Lincoln	66	6	53	101
	Ouachita	300	641	449	106
	Union	90	285	100	13
	Winn	906	689	96	---
District 2 total		2,537	3,246	1,298	596
3	E. Carroll	319	649	46	249
	Franklin	323	1,466	657	276
	Madison	---	927	412	3,069
	Morehouse	102	959	355	187
	Richland	689	1,311	724	390
	Tensas	640	1,930	881	1,286
	W. Carroll	177	279	86	349
District 3 total		2,250	7,521	3,161	5,806
4	Natchitoches	833	2,732	1,443	686
	Sabine	779	554	604	82
	Vernon	6,575	4,316	5,808	4,165
District 4 total		8,187	7,602	7,855	4,933
5	Avoyelles	403	389	551	906
	Catahoula	122	377	325	172
	Concordia	238	101	102	20
	Evangeline	---	7,611	923	1,459
	Grant	427	1,141	1,180	125
	LaSalle	182	256	36	100
	Pt. Coupee	233	1,627	770	706
	Rapides	3,831	8,181	3,339	3,665
	St. Landry	3,476	1,845	1,298	613
	W. B. Rouge	38	309	305	215
District 5 total		8,950	21,837	8,829	7,981

(Continued)

Table 27.--The value in dollars of wool shorn, by parishes, 1910, 1920, 1930, and 1950--Continued

District	Parish	Agricultural census year			
		1910	1920	1930	1950
		Dollars			
6	E. B. Rouge	871	2,271	1,138	362
	E. Feliciana	598	1,809	1,331	200
	Livingston	1,221	2,110	535	101
	St. Helena	188	2,123	46	---
	St. Tammany	3,986	17,728	12,664	557
	Tangipahoa	3,205	8,552	2,257	710
	Washington	4,632	7,813	2,276	189
	W. Feliciana	232	1,066	728	200
District 6 total		14,933	43,472	20,975	2,319
7	Acadia	400	1,549	1,154	2,620
	Allen	---	14,015	10,767	6,439
	Beauregard	---	58,544	57,018	41,461
	Calcasieu	35,545	6,489	8,466	9,404
	Cameron	923	789	1,229	1,724
	Jeff Davis	---	2,770	3,342	3,023
	Vermilion	326	984	2,028	2,867
District 7 total		37,194	85,140	84,004	67,538
8	Assumption	106	41	162	585
	Iberia	110	535	335	362
	Iberville	---	631	448	769
	Lafayette	427	1,007	490	393
	St. Martin	140	284	547	323
	St. Mary	37	148	110	60
District 8 total		820	2,646	2,092	2,492
9	Ascension	131	358	365	1,497
	Jefferson	---	---	114	168
	Lafourche	19	250	164	172
	Orleans	---	---	---	22
	Plaquemines	44	---	---	29
	St. Bernard	---	---	26	---
	St. Charles	---	104	5	20
	St. James	23	39	74	530
	St. John	7	6	37	1,250
	Terrebonne	30	25	73	256
District 9 total		254	782	858	3,944
State total		77,734	175,770	130,065	97,430

Table 28.--Number of farms reporting sheep and lambs shorn, by parishes, 1930-1954

District	Parish	Agricultural census year					
		1930	1935	1940	1945	1950	1954
		Number					
1	Bossier	10	10	15	7	6	13
	Caddo	8	14	15	17	14	28
	DeSoto	13	22	20	8	13	21
	Red River	2	2	2	--	--	8
	Webster	13	14	6	7	7	7
District 1 total		46	62	58	39	40	77
2	Bienville	7	9	3	3	5	6
	Caldwell	9	7	3	3	1	3
	Claiborne	6	7	3	1	8	3
	Jackson	1	--	--	--	--	--
	Lincoln	7	4	2	2	3	2
	Ouachita	9	3	4	1	3	5
	Union	6	4	5	2	2	2
	Winn	6	5	4	2	--	1
District 2 total		51	39	24	14	22	22
3	E. Carroll	2	4	3	2	4	4
	Franklin	20	39	15	10	12	20
	Madison	3	10	10	10	7	13
	Morehouse	4	11	8	7	7	10
	Richland	24	29	16	5	4	13
	Tensas	24	32	20	21	20	20
	W. Carroll	4	4	4	3	5	9
District 3 total		81	129	76	58	59	89
4	Natchitoches	47	51	46	22	24	21
	Sabine	20	16	13	11	4	4
	Vernon	47	119	138	71	30	23
District 4 total		114	186	197	104	53	48
5	Avoyelles	31	49	20	35	19	37
	Catahoula	12	17	9	10	5	7
	Concordia	7	10	5	2	1	7
	Evangeline	41	78	100	36	40	58
	Grant	11	8	4	7	7	3
	LaSalle	4	6	4	1	1	3
	Pt. Coupee	36	26	34	25	11	10
	Rapides	85	120	90	92	44	60
	St. Landry	86	116	84	101	58	86
	W. B. Rouge	13	2	2	2	2	3
District 5 total		326	432	352	311	188	274

(Continued)

Table 28.--Number of farms reporting sheep and lambs shorn, by parishes, 1930-1954--Continued

District	Parish	Agricultural census year					
		1930	1935	1940	1945	1950	1954
		Number					
6	E. B. Rouge	48	44	20	10	12	11
	E. Feliciana	32	35	10	15	13	6
	Livingston	20	53	34	37	6	17
	St. Helena	3	3	2	1	--	--
	St. Tammany	92	87	89	74	22	42
	Tangipahoa	39	68	47	22	20	16
	Washington	39	59	34	14	9	10
	W. Feliciana	22	19	21	11	4	7
District 6 total		295	368	257	184	86	109
7	Acadia	69	188	185	131	187	287
	Allen	153	164	150	68	59	69
	Beauregard	177	220	182	164	109	96
	Calcasieu	86	138	151	114	112	86
	Cameron	29	118	131	65	51	57
	Jeff Davis	138	187	196	132	172	142
	Vermilion	147	298	327	261	273	260
District 7 total		799	1,313	1,322	935	963	997
8	Assumption	6	6	4	1	2	3
	Iberia	20	53	17	18	13	19
	Iberville	14	8	5	4	4	2
	Lafayette	42	121	44	50	38	44
	St. Martin	40	47	43	14	21	9
	St. Mary	4	8	4	8	4	1
District 8 total		126	243	117	95	82	78
9	Ascension	43	66	32	13	21	7
	Jefferson	2	--	1	6	6	3
	Lafourche	7	2	5	2	2	1
	Orleans	--	--	1	--	1	--
	Plaquemines	--	--	--	1	2	2
	St. Bernard	2	2	1	1	--	--
	St. Charles	2	7	5	2	1	4
	St. James	8	11	5	1	4	1
	St. John	7	13	3	1	5	4
	Terrebonne	2	5	1	--	3	1
District 9 total		73	106	54	27	45	23
State total		1,911	2,878	2,457	1,767	1,543	1,717

Table 29.--Number of sheep and lambs shorn, by parishes, 1910-1954

District	Parish	Agricultural census year						
		1910	1925	1930	1935	1940	1950	1954
		Number						
1	Bossier	1,278	291	251	219	282	363	1,129
	Caddo	278	266	94	230	342	213	813
	DeSoto	1,208	747	219	458	462	438	382
	Red River	166	18	5	14	(1)	---	364
	Webster	847	301	202	237	183	124	122
District 1 total		3,777	1,623	771	1,158	1,269	1,138	2,810
2	Bienville	578	287	93	97	27	33	274
	Caldwell	574	276	223	172	37	34	101
	Claiborne	382	200	138	140	37	125	65
	Jackson	542	224	12	---	---	---	---
	Lincoln	133	56	43	46	(1)	35	14
	Ouachita	478	327	266	115	48	50	145
	Union	157	111	130	29	53	9	8
	Winn	1,623	219	92	89	65	---	30
District 2 total		4,467	1,700	997	688	267	286	637
3	E. Carroll	548	---	40	127	69	207	492
	Franklin	499	539	351	703	268	139	539
	Madison	---	302	245	2,289	509	2,263	739
	Morehouse	241	206	210	352	78	100	285
	Richland	1,133	201	582	819	310	210	624
	Tensas	1,188	310	817	1,428	1,043	662	975
	W. Carroll	233	131	86	25	120	160	815
District 3 total		3,842	1,689	2,331	5,743	2,397	3,741	4,469
4	Natchitoches	1,820	1,287	1,436	1,746	1,775	593	687
	Sabine	1,176	573	527	298	369	50	54
	Vernon	8,334	3,838	5,577	11,090	14,698	2,714	1,768
District 4 total		11,330	5,698	7,540	13,134	16,842	3,357	2,509
5	Avoyelles	478	492	448	533	244	636	1,666
	Catahoula	288	150	248	255	108	113	537
	Concordia	168	19	87	195	554	15	872
	Evangeline	---	5,438	1,104	3,598	5,457	640	599
	Grant	656	323	760	162	56	74	118
	LaSalle	307	213	42	52	66	65	70
	Pt. Coupee	428	769	688	228	399	636	809
	Rapides	5,339	3,111	3,206	4,996	4,242	2,474	3,061
	St. Landry	5,415	1,180	962	1,240	894	367	769
	W. B. Rouge	98	93	197	11	(1)	133	594
District 5 total		13,177	11,788	7,742	11,270	12,020	5,153	9,095

(Continued)

Table 29.--Number of sheep and lambs shorn, by parishes, 1910-1954--Continued

District	Parish	1910	1925	1930	1935	1940	1950	1954
		Number						
6	E. B. Rouge	1,174	510	876	451	399	154	245
	E. Feliciana	989	887	906	696	174	136	86
	Livingston	1,756	785	514	1,350	1,110	85	321
	St. Helena	163	608	19	93	(1)	---	---
	St. Tammany	4,882	6,340	10,044	10,857	12,354	370	1,086
	Tangipahoa	3,886	3,893	2,308	3,175	2,894	514	1,712
	Washington	6,446	4,301	2,864	3,324	2,390	109	553
	W. Feliciana	417	600	609	343	373	95	309
District 6 total		19,713	17,924	18,140	20,289	19,694	1,463	4,312
7	Acadia	569	1,240	847	2,083	2,010	1,668	2,813
	Allen	---	7,054	11,768	10,156	12,756	6,090	7,030
	Beauregard	---	30,781	62,430	99,825	79,801	28,560	21,236
	Calcasieu	46,273	3,531	8,387	22,798	22,176	5,526	10,106
	Cameron	1,130	1,906	1,205	1,706	2,645	1,165	1,472
	Jeff Davis	---	2,135	2,812	2,808	3,953	1,884	1,946
	Vermilion	605	2,072	1,953	3,250	3,387	2,277	2,963
District 7 total		48,577	48,719	89,402	142,626	126,728	47,170	47,566
8	Assumption	195	170	167	62	74	520	473
	Iberia	226	291	371	500	159	174	712
	Iberville	---	257	445	223	365	412	187
	Lafayette	465	671	358	805	457	267	436
	St. Martin	249	300	457	628	587	208	151
	St. Mary	20	142	102	265	30	32	13
District 8 total		1,155	1,831	1,900	2,483	1,672	1,613	1,972
9	Ascension	281	308	296	528	290	1,113	2,012
	Jefferson	---	113	116	---	(1)	153	70
	Lafourche	22	48	189	141	133	175	374
	Orleans	---	---	---	---	(1)	4	---
	Plaquemines	106	10	---	---	---	15	20
	St. Bernard	---	7	21	25	(1)	---	---
	St. Charles	---	95	7	320	35	8	425
	St. James	16	97	82	121	45	526	800
	St. John	8	85	23	90	26	423	1,648
	Terrebonne	50	197	64	14	(1)	155	2
District 9 total		483	960	798	1,239	529	2,572	5,351
State total		106,521	91,932	129,621	198,630	181,601	66,493	78,721

---

[1] Where there are less than 3 farms reporting, data are included only in the state totals. (183 included in 1940).

Table 30.--Number of pounds of wool shorn, by parishes, 1910-1954

District	Parish	Agricultural census year							
		1910	1920	1930	1935	1940	1945	1950	1954
		Pounds							
1	Bossier	4,102	2,846	1,161	797	1,385	595	1,365	7,767
	Caddo	892	1,215	306	890	1,646	1,392	915	4,771
	DeSoto	3,878	3,622	1,018	2,084	2,076	1,030	1,636	1,839
	Red River	533	220	18	115	46	---	---	2,126
	Webster	2,719	587	922	1,020	712	600	572	597
District 1 total		12,124	8,490	3,425	4,906	5,865	3,617	4,488	17,100
2	Bienville	1,855	1,667	402	394	95	210	187	1,264
	Caldwell	1,843	588	1,012	821	135	330	160	471
	Claiborne	1,226	1,578	536	713	161	100	588	358
	Jackson	1,740	424	48	---	---	---	---	---
	Lincoln	427	15	176	138	31	162	238	79
	Ouachita	1,534	1,762	1,498	431	170	60	270	1,016
	Union	504	674	333	94	347	190	28	37
	Winn	5,210	1,565	320	244	294	520	---	180
District 2 total		14,339	8,273	4,325	2,835	1,233	1,572	1,471	3,405
3	E. Carroll	1,759	1,626	160	864	380	1,010	606	3,840
	Franklin	1,602	4,103	2,266	3,560	1,130	824	728	2,569
	Madison	---	2,300	1,420	13,442	2,858	1,677	6,857	3,226
	Morehouse	774	2,624	1,225	1,360	391	1,169	422	1,713
	Richland	3,637	3,071	2,498	4,227	1,088	594	815	2,633
	Tensas	3,813	4,578	3,038	6,440	4,333	3,260	3,176	4,876
	W. Carroll	748	823	295	97	554	939	925	5,042
District 3 total		12,333	19,125	10,902	29,990	10,734	9,473	13,529	23,899

(Continued)

Table 30.--Number of pounds of wool shorn, by parishes, 1910-1954--Continued

Dist-rict	Parish	Agricultural census year							
		1910	1920	1930	1935	1940	1945	1950	1954
		Pounds							
4	Natchitoches	5,842	6,088	4,654	6,974	6,293	5,789	2,058	2,834
	Sabine	3,775	1,422	1,949	308	1,228	991	204	456
	Vernon	26,752	8,148	18,736	36,167	47,160	22,763	9,889	5,889
District 4 total		36,369	15,658	25,339	43,949	54,681	29,543	12,151	9,179
5	Avoyelles	1,534	1,070	1,778	2,304	930	1,299	2,609	8,206
	Catahoula	924	1,094	1,047	971	360	1,375	401	1,796
	Concordia	539	295	330	637	1,975	60	45	5,780
	Evangeline	---	14,146	2,978	12,191	20,059	7,606	3,285	3,240
	Grant	2,106	2,351	3,806	534	147	1,079	355	927
	LaSalle	985	510	115	207	222	40	240	366
	Pt. Coupee	1,374	4,436	2,484	989	1,625	1,224	1,997	5,167
	Rapides	17,138	16,579	10,772	17,671	20,082	10,679	8,941	11,447
	St. Landry	17,382	4,680	4,187	5,570	4,907	4,693	1,805	3,685
	W. B. Rouge	315	773	984	65	160	450	494	2,919
District 5 total		42,297	45,934	28,481	41,139	50,467	28,505	20,172	43,533
6	E. B. Rouge	3,769	5,622	3,555	1,559	1,946	1,015	798	1,166
	E. Feliciana	3,175	5,982	4,160	2,811	673	1,076	570	489
	Livingston	5,637	4,147	1,671	4,400	3,209	4,912	267	1,622
	St. Helena	523	4,488	144	260	115	400	---	---
	St. Tammany	15,671	29,840	39,575	33,729	32,713	42,542	1,445	5,113
	Tangipahoa	12,474	14,885	7,054	9,517	9,220	6,554	1,678	8,014
	Washington	20,692	12,859	7,111	10,680	7,499	4,000	452	2,680
	W. Feliciana	1,339	2,876	2,274	1,381	1,521	980	436	1,631
District 6 total		63,280	80,699	65,544	64,337	56,896	61,479	5,646	20,715

(Continued)

Table 30.—Number of pounds of wool shorn, by parishes, 1910-1954—Continued

District	Parish	Agricultural census year							
		1910	1920	1930	1935	1940	1945	1950	1954
		Pounds							
7	Acadia	1,826	3,616	3,723	8,109	8,453	8,107	7,768	13,760
	Allen	—	24,927	34,731	32,515	39,537	19,177	15,982	18,947
	Beauregard	—	106,644	183,930	330,314	248,825	209,681	91,259	70,724
	Calcasieu	148,536	13,337	27,309	75,557	74,756	47,099	22,054	40,020
	Cameron	3,627	1,872	3,964	6,736	11,660	9,526	4,616	6,205
	Jeff Davis	—	5,762	10,781	11,707	17,374	9,565	9,161	9,551
	Vermilion	1,942	2,580	6,543	10,222	12,302	14,263	9,127	13,072
District 7 total		155,931	158,738	270,981	475,160	412,907	317,418	159,967	172,279
8	Assumption	626	82	505	168	263	60	1,300	1,528
	Iberia	725	1,070	1,048	1,271	360	700	923	2,860
	Iberville	—	1,217	1,401	935	942	725	1,744	736
	Lafayette	1,493	2,361	1,532	2,976	2,613	1,390	1,158	2,612
	St. Martin	799	823	1,710	2,102	1,853	1,484	784	716
	St. Mary	642	398	344	1,040	93	357	140	52
District 8 total		4,285	5,951	6,540	8,492	6,124	4,716	6,049	8,504
9	Ascension	902	889	1,107	2,067	1,204	407	3,718	7,096
	Jefferson	—	—	344	—	80	1,351	490	350
	Lafourche	71	410	496	232	351	700	387	1,225
	Orleans	—	—	—	—	242	—	40	—
	Plaquemines	340	—	—	—	—	32	70	120
	St. Bernard	—	—	80	78	34	100	—	—
	St. Charles	—	200	15	1,060	196	240	40	1,784
	St. James	51	79	223	406	202	15	1,255	4,000
	St. John	26	18	113	220	65	5	2,088	7,257
	Terrebonne	160	50	220	61	5	—	763	15
District 9 total		1,550	1,646	2,598	4,124	2,379	2,850	8,851	21,847
State total		342,508	344,514	418,135	674,932	601,286	459,173	232,324	320,461

Table 31.--Number of farms reporting horses and/or mules, by parishes, 1930-1954

District	Parish	Agricultural census year				
		1930	1935	1940	1950	1954
		Number				
1	Bossier	3,200	2,795	2,030	1,207	1,109
	Caddo	5,304	3,930	2,825	1,648	1,159
	DeSoto	4,103	3,186	3,632	2,083	1,797
	Red River	2,366	1,610	1,605	982	676
	Webster	2,704	2,465	2,288	1,371	956
District 1 total		17,677	13,986	12,380	7,291	5,697
2	Bienville	2,968	2,413	2,624	1,542	1,060
	Caldwell	1,129	1,271	1,105	772	631
	Claiborne	3,751	3,187	2,922	1,884	1,363
	Jackson	1,416	1,288	1,347	727	611
	Lincoln	2,500	2,991	2,416	1,312	922
	Ouachita	1,945	2,002	1,656	1,041	768
	Union	2,334	3,188	2,967	1,425	1,187
	Winn	1,527	1,673	1,426	890	606
District 2 total		17,570	18,013	16,463	9,593	7,148
3	E. Carroll	2,735	1,559	2,270	1,070	575
	Franklin	5,008	4,112	4,015	2,677	1,774
	Madison	1,844	1,431	1,150	870	575
	Morehouse	2,752	2,760	2,249	1,805	1,185
	Richland	4,252	3,710	4,184	2,279	1,345
	Tensas	1,718	1,437	1,113	811	460
	W. Carroll	2,289	2,428	2,614	1,811	856
District 3 total		20,598	17,437	17,595	11,323	6,770
4	Natchitoches	4,392	4,566	3,495	2,154	1,623
	Sabine	2,615	2,576	2,192	1,490	1,100
	Vernon	1,601	1,930	1,728	1,599	1,229
District 4 total		8,608	9,072	7,415	5,243	3,952
5	Avoyelles	4,251	4,915	4,397	3,377	2,242
	Catahoula	1,567	1,967	1,470	1,140	905
	Concordia	1,309	1,751	1,303	792	631
	Evangeline	4,035	4,195	3,981	3,163	2,399
	Grant	1,455	1,580	1,113	811	597
	LaSalle	655	874	631	612	438
	Pt. Coupee	2,029	2,199	2,393	1,648	1,285
	Rapides	3,129	3,657	2,563	2,371	1,882
	St. Landry	6,151	7,621	6,961	5,983	4,955
	W. B. Rouge	351	427	453	312	256
District 5 total		24,932	29,186	25,265	20,209	15,590

(Continued)

Table 31.--Number of farms reporting horses and/or mules, by parishes, 1930-1954--Continued

District	Parish	Agricultural census year				
		1930	1935	1940	1950	1954
		Number				
6	E. B. Rouge	1,959	1,893	1,503	1,385	1,146
	E. Feliciana	1,803	1,593	1,844	1,357	1,116
	Livingston	1,768	1,724	1,811	1,710	1,440
	St. Helena	1,289	1,201	1,435	1,273	1,100
	St. Tammany	981	1,056	973	986	729
	Tangipahoa	3,449	3,474	3,466	3,534	2,520
	Washington	2,039	2,403	2,688	2,206	1,584
	W. Feliciana	1,173	1,152	1,120	675	526
District 6 total		14,461	14,496	14,840	13,126	10,161
7	Acadia	3,374	3,757	3,462	2,557	1,991
	Allen	992	1,217	1,112	1,019	772
	Beauregard	1,170	1,477	1,325	1,281	814
	Calcasieu	1,335	1,839	1,493	1,233	756
	Cameron	729	857	758	508	440
	Jeff Davis	1,447	1,699	1,402	1,093	762
	Vermilion	3,059	3,465	2,978	2,386	1,600
District 7 total		12,106	14,311	12,530	10,077	7,135
8	Assumption	401	411	466	278	188
	Iberia	925	1,417	1,196	801	591
	Iberville	537	806	684	522	369
	Lafayette	3,117	3,360	3,105	2,544	2,168
	St. Martin	1,978	2,577	2,139	1,856	1,540
	St. Mary	444	372	305	265	234
District 8 total		7,402	8,943	7,895	6,266	5,090
9	Ascension	1,213	1,204	1,295	1,024	755
	Jefferson	143	230	178	113	96
	Lafourche	1,050	1,197	1,036	738	438
	Orleans	48	108	84	41	9
	Plaquemines	165	409	330	239	92
	St. Bernard	81	163	80	76	50
	St. Charles	159	283	236	132	62
	St. James	291	558	389	190	145
	St. John	159	265	156	107	76
	Terrebonne	589	933	634	407	219
District 9 total		3,898	5,350	4,418	3,067	1,942
State total		127,252	130,794	118,801	86,195	63,485

Table 32.--Number of horses and colts on farms, by parishes, 1910-1954

Dist-: rict	Parish	Agricultural census year: 1910	1920	1930 1/	1935	1940	1945	1950	1954
		- - - - - - - - - - - - - - - -			Number	- - - - - - - - - - - - - - - -			
1	Bossier	2,221	2,701	1,404	1,634	1,746	1,356	1,197	1,159
	Caddo	3,837	3,779	2,940	2,584	2,601	2,424	2,503	1,688
	DeSoto	4,426	3,987	2,151	2,355	3,328	3,082	3,138	2,407
	Red River	1,988	2,224	1,479	1,324	1,482	1,047	999	864
	Webster	2,673	1,509	874	1,045	1,239	1,242	1,233	963
District 1 total		15,145	14,200	8,848	8,942	10,396	9,151	9,070	7,081
2	Bienville	2,401	2,099	1,064	1,053	1,469	1,406	1,078	725
	Caldwell	1,274	1,206	690	702	939	984	904	766
	Claiborne	2,950	2,895	1,212	1,137	1,640	1,447	1,603	1,154
	Jackson	1,440	1,900	774	632	786	664	542	415
	Lincoln	1,832	1,657	1,066	949	1,284	1,034	1,121	670
	Ouachita	2,108	1,684	1,198	1,008	1,330	1,251	934	771
	Union	2,513	2,294	1,094	1,089	1,165	726	866	891
	Winn	1,830	1,827	1,004	1,104	1,019	1,038	721	538
District 2 total		16,348	15,562	8,102	7,674	9,632	8,550	7,769	5,930
3	E. Carroll	1,615	1,846	1,071	826	832	905	856	443
	Franklin	3,124	5,351	3,590	2,861	3,529	3,611	3,647	2,021
	Madison	1,664	1,400	944	933	1,008	829	1,003	656
	Morehouse	3,063	3,627	1,903	1,821	2,318	2,354	2,524	1,359
	Richland	2,981	3,699	2,189	1,982	2,850	2,463	2,418	1,418
	Tensas	2,437	2,103	1,486	1,549	1,863	1,463	1,352	946
	W. Carroll	1,697	1,625	1,323	1,292	2,167	1,925	1,948	737
District 3 total		16,581	19,651	12,506	11,264	14,567	13,550	13,748	7,580

(Continued)

Table 32.--Number of horses and colts on farms, by parishes, 1910-1954--Continued

Dist-: rict	Parish	Agricultural census year							
		1910	1920	1930 1/	1935	1940	1945	1950	1954
		- Number -							
4	Natchitoches	6,933	7,351	4,350	4,289	4,756	3,445	3,255	2,152
	Sabine	2,642	2,871	1,641	1,753	2,080	1,919	1,696	1,231
	Vernon	2,028	1,849	1,777	2,097	2,591	2,612	2,520	1,961
District 4 total		11,603	12,071	7,768	8,139	9,427	7,976	7,471	5,344
5	Avoyelles	8,054	8,498	4,671	4,916	6,079	6,158	4,349	2,732
	Catahoula	2,111	2,589	1,734	1,530	2,178	2,715	2,002	1,437
	Concordia	2,025	2,251	1,472	2,039	2,331	1,908	1,435	1,189
	Evangeline	---	7,884	6,212	6,764	8,766	8,010	5,745	3,755
	Grant	1,844	2,362	1,469	1,433	1,129	1,322	1,057	689
	LaSalle	1,136	1,326	885	1,099	938	1,023	928	732
	Pt. Coupee	2,317	4,305	3,005	2,988	3,610	4,278	2,740	1,596
	Rapides	4,940	5,191	3,430	3,621	3,377	3,908	4,043	2,982
	St. Landry	20,669	11,926	7,355	8,727	10,894	11,056	8,401	5,733
	W. B. Rouge	965	749	581	633	704	657	552	438
District 5 total		44,061	47,081	30,814	33,750	40,006	41,035	31,252	21,283
6	E. B. Rouge	3,255	4,304	2,834	2,212	2,264	2,514	2,848	1,937
	E. Feliciana	2,892	3,377	2,529	1,905	1,485	2,316	2,171	1,568
	Livingston	1,519	1,830	1,615	1,414	1,576	1,692	1,686	1,602
	St. Helena	1,271	1,985	1,212	991	1,133	1,336	1,278	933
	St. Tammany	948	1,125	1,135	1,044	1,108	1,397	1,427	1,030
	Tangipahoa	2,787	3,467	2,421	1,712	1,840	2,859	2,814	2,102
	Washington	1,959	2,369	1,332	1,060	1,478	1,375	1,206	847
	W. Feliciana	2,058	3,032	2,009	1,774	1,914	2,092	1,543	1,077
District 6 total		16,689	21,489	15,087	12,112	12,798	15,581	14,973	11,096

(Continued)

Table 32.--Number of horses and colts on farms, by parishes, 1910-1954--Continued

District	Parish	1910	1920	1930 [1]	1935	1940	1945	1950	1954
		Number							
7	Acadia	10,186	8,677	5,243	5,908	7,361	6,116	4,486	2,876
	Allen	---	2,160	1,775	1,961	2,407	2,011	2,057	1,463
	Beauregard	---	1,749	1,698	1,870	2,439	2,782	2,578	1,491
	Calcasieu	10,691	2,794	3,394	4,291	5,485	4,315	4,351	2,204
	Cameron	2,458	2,060	2,141	3,372	3,036	4,030	2,694	1,909
	Jeff Davis	---	4,636	4,246	4,944	5,290	4,041	3,036	1,650
	Vermilion	9,678	5,948	3,627	5,010	6,529	6,377	4,658	2,703
District 7 total		33,013	28,024	22,124	27,356	32,547	29,672	23,860	14,296
8	Assumption	627	505	317	388	318	252	275	137
	Iberia	2,979	2,049	879	1,139	949	1,133	852	564
	Iberville	1,857	1,168	810	1,076	1,120	738	1,110	710
	Lafayette	8,785	6,008	3,673	4,135	4,976	5,602	3,910	2,562
	St. Martin	4,947	3,048	1,609	1,741	2,067	1,627	1,519	822
	St. Mary	1,369	496	319	232	220	277	299	108
District 8 total		20,564	13,274	7,607	8,711	9,650	9,629	7,965	4,903
9	Ascension	1,922	2,873	1,644	1,272	1,578	1,573	1,697	922
	Jefferson	361	314	122	140	164	250	343	207
	Lafourche	1,916	1,704	746	408	500	462	625	423
	Orleans	576	290	55	79	89	94	99	21
	Plaquemines	703	569	146	327	403	520	571	136
	St. Bernard	155	67	49	83	37	155	113	55
	St. Charles	345	345	181	241	131	303	324	171
	St. James	548	363	258	449	217	195	157	160
	St. John	211	239	92	151	75	118	90	80
	Terrebonne	545	640	284	260	143	195	277	198
District 9 total		7,282	7,404	3,577	3,410	3,337	3,865	4,296	2,423
State total		181,286	178,756	116,433	121,358	142,360	139,009	120,404	79,936

---

[1] Figures exclude colts under three months old.

Table 33.--Number of mules and mule colts on farms, by parishes, 1910-1954

Dist-rict	Parish	Agricultural census year							
		1910	1920	1930	1935	1940	1945	1950	1954
		Number							
1	Bossier	3,793	5,450	5,528	5,083	3,850	2,931	1,700	1,087
	Caddo	5,608	5,854	9,197	7,399	6,331	4,163	2,620	1,334
	DeSoto	3,379	4,711	5,415	4,381	4,252	3,230	2,409	1,709
	Red River	1,790	2,493	3,677	2,813	2,772	2,375	1,539	760
	Webster	1,671	2,760	4,490	4,101	3,642	2,680	1,976	1,019
District 1 total		16,241	21,268	28,307	23,777	20,847	15,379	10,244	5,909
2	Bienville	2,710	3,783	4,678	3,936	3,687	2,674	1,810	956
	Caldwell	797	1,163	1,585	1,472	1,267	1,333	815	420
	Claiborne	3,977	4,994	5,946	5,482	4,782	3,927	2,888	1,468
	Jackson	1,609	2,278	1,918	1,599	1,573	1,465	643	467
	Lincoln	2,445	2,675	4,073	4,073	3,603	2,722	1,659	842
	Ouachita	2,364	2,965	3,033	2,857	2,481	1,906	1,311	650
	Union	2,874	3,723	3,675	4,089	3,953	3,358	1,830	978
	Winn	1,179	1,550	1,773	1,552	1,458	1,135	760	431
District 2 total		17,955	23,131	26,681	25,060	22,804	18,520	11,716	6,212
3	E. Carroll	2,273	2,724	4,476	3,506	4,172	3,145	2,385	838
	Franklin	1,606	5,193	7,269	6,644	6,317	5,457	3,629	1,706
	Madison	2,087	2,456	3,490	2,777	3,197	2,695	1,590	754
	Morehouse	2,828	3,841	5,063	5,125	4,427	4,438	3,721	2,382
	Richland	1,684	3,727	6,043	5,363	6,069	4,971	3,763	1,847
	Tensas	2,858	2,415	3,517	3,104	2,602	2,451	1,505	593
	W. Carroll	669	1,601	3,382	3,710	4,317	3,964	2,994	1,074
District 3 total		14,005	21,957	33,240	30,229	31,101	27,121	19,587	9,194

(Continued)

Table 33.--Number of mules and mule colts on farms, by parishes, 1910-1954--Continued

Dist-: rict	Parish	Agricultural census year							
		1910	1920	1930	1935	1940	1945	1950	1954
		Number							
4	Natchitoches	3,496	5,354	6,981	7,143	5,377	3,427	2,697	1,381
	Sabine	1,220	2,583	2,983	2,798	2,180	1,638	1,265	710
	Vernon	398	651	871	979	898	938	844	487
District 4 total		5,114	8,588	10,835	10,920	8,455	6,003	4,806	2,578
5	Avoyelles	2,301	3,865	5,121	5,844	5,024	5,033	3,847	2,006
	Catahoula	1,200	1,771	2,179	2,257	2,022	1,219	1,231	656
	Concordia	1,971	2,224	1,746	1,994	1,633	1,323	763	452
	Evangeline	---	2,442	4,284	3,920	2,957	3,252	3,067	2,274
	Grant	1,251	1,469	1,687	1,896	1,415	1,134	698	359
	LaSalle	285	347	266	335	314	230	205	93
	Pt. Coupee	2,564	4,474	3,345	3,363	3,946	4,178	2,831	1,645
	Rapides	3,066	4,216	5,249	5,669	4,067	2,828	1,778	987
	St. Landry	4,886	7,808	10,507	11,780	10,265	10,886	10,757	8,164
	W. B. Rouge	2,088	2,306	987	1,337	1,282	1,034	523	301
District 5 total		19,612	30,922	35,371	38,395	32,925	31,117	25,700	16,937
6	E. B. Rouge	2,841	2,784	1,953	1,802	1,751	1,631	1,115	511
	E. Feliciana	2,458	3,061	2,715	2,339	2,286	2,448	1,965	1,331
	Livingston	442	517	946	944	996	966	740	407
	St. Helena	683	906	1,030	937	1,279	1,147	1,037	820
	St. Tammany	121	325	420	438	513	558	401	210
	Tangipahoa	608	1,695	2,641	3,188	3,205	3,811	2,523	1,436
	Washington	936	1,856	2,404	2,671	3,452	3,391	2,533	1,572
	W. Feliciana	1,424	1,860	1,375	1,522	1,547	1,623	1,078	863
District 6 total		9,513	13,004	13,484	13,841	15,029	15,575	11,392	7,150

(Continued)

Table 33.--Number of mules and mule colts on farms, by parishes, 1910-1954--Continued

Dist-rict	Parish	Agricultural census year							
		1910	1920	1930	1935	1940	1945	1950	1954
		Number							
7	Acadia	3,984	7,244	7,143	6,570	5,038	4,346	4,111	2,403
	Allen	---	643	908	890	608	451	537	240
	Beauregard	---	481	745	884	634	632	486	291
	Calcasieu	4,209	1,548	2,069	1,882	849	686	638	254
	Cameron	191	289	686	484	256	213	220	126
	Jeff Davis	---	3,767	3,131	2,751	1,626	1,228	596	205
	Vermilion	3,212	7,555	6,843	7,285	5,336	5,381	3,782	1,744
District 7 total		11,596	21,527	21,525	20,746	14,347	12,937	10,370	5,263
8	Assumption	3,192	2,911	2,650	2,377	1,998	1,441	859	442
	Iberia	4,939	4,192	2,938	4,307	3,897	3,753	2,181	1,217
	Iberville	3,001	4,083	2,298	2,605	2,020	1,603	942	557
	Lafayette	2,767	5,358	6,165	7,081	5,637	5,942	5,601	4,023
	St. Martin	2,540	3,731	4,206	5,336	4,911	4,866	4,001	2,889
	St. Mary	5,319	3,384	2,557	2,310	1,466	1,445	966	589
District 8 total		22,758	23,659	20,814	24,016	19,929	19,050	14,550	9,717
9	Ascension	1,513	2,694	1,405	1,354	1,463	1,239	877	452
	Jefferson	947	492	228	323	251	184	72	51
	Lafourche	3,456	3,950	3,099	3,294	3,012	2,921	1,540	645
	Orleans	364	213	15	100	70	121	41	19
	Plaquemines	963	742	255	389	274	212	106	47
	St. Bernard	550	331	38	243	159	199	99	41
	St. Charles	940	1,124	353	558	609	367	237	45
	St. James	2,682	2,058	1,428	1,455	1,203	805	442	221
	St. John	1,179	1,262	1,297	1,366	667	715	355	179
	Terrebonne	2,166	3,193	2,367	2,682	1,777	1,752	750	311
District 9 total		14,760	16,059	10,495	11,764	9,485	8,515	4,519	2,011
State total		131,554	180,115	200,752	198,748	174,922	154,217	112,884	64,971

Table 34.—The value in dollars of chickens raised on farms, by parishes, 1910-1954

District	Parish	Agricultural census year						
		1910	1930	1935	1940	1945	1950	1954
		Dollars						
1	Bossier	18,485	49,856	34,758	29,828	68,228	47,555	38,273
	Caddo	30,845	80,804	49,503	45,694	104,168	86,163	45,253
	DeSoto	25,711	54,740	35,358	41,584	86,014	66,395	215,613
	Red River	11,194	32,605	22,536	23,259	43,379	44,533	58,712
	Webster	15,910	52,850	38,904	30,969	66,396	54,318	112,437
District 1 total		102,145	270,855	181,059	171,334	368,185	298,964	470,288
2	Bienville	20,305	49,567	32,346	32,751	72,285	62,170	169,952
	Caldwell	8,274	20,878	16,104	14,334	41,452	32,209	4,159
	Claiborne	20,969	59,736	41,932	33,989	83,233	73,505	25,649
	Jackson	10,428	28,614	17,778	18,415	47,546	25,273	315,892
	Lincoln	19,094	53,798	35,599	30,459	65,970	57,346	670,906
	Ouachita	16,675	46,063	27,149	23,403	64,950	48,901	186,745
	Union	19,483	56,796	38,064	41,508	100,412	60,924	714,578
	Winn	12,289	27,475	21,650	18,508	47,388	34,220	61,526
District 2 total		127,517	342,927	230,622	213,367	523,236	394,548	2,149,407
3	E. Carroll	10,005	29,620	23,297	23,617	53,350	40,406	43,104
	Franklin	14,538	79,230	64,789	57,292	159,950	107,601	186,879
	Madison	12,343	25,414	18,985	21,396	61,883	40,099	12,802
	Morehouse	14,318	47,062	33,207	27,965	81,913	62,805	35,603
	Richland	15,856	58,113	48,967	46,083	111,312	78,457	35,662
	Tensas	12,403	18,071	19,140	16,110	52,931	30,557	4,348
	W. Carroll	5,991	33,226	33,263	37,564	93,320	71,133	50,640
District 3 total		85,454	290,736	241,648	230,027	614,659	431,058	369,038

(Continued)

Table 34.--The value in dollars of chickens raised on farms, by parishes, 1910-1954--Continued

District	Parish	Agricultural census year 1910	1930	1935	1940	1945	1950	1954
					Dollars			
4	Natchitoches	28,577	76,954	54,849	44,649	94,554	83,546	734,121
	Sabine	18,350	47,698	34,344	28,483	56,506	48,579	496,776
	Vernon	12,714	34,811	22,317	22,751	64,008	62,627	47,807
District 4 total		59,641	159,463	111,510	95,883	215,068	194,752	1,278,704
5	Avoyelles	44,195	116,517	75,435	76,954	255,380	186,112	116,999
	Catahoula	11,384	31,332	25,054	23,951	76,178	52,019	10,591
	Concordia	8,806	17,076	14,779	15,169	40,899	36,388	23,322
	Evangeline	---	123,085	71,132	77,124	189,154	149,970	31,296
	Grant	10,000	30,203	22,117	14,918	50,901	31,728	67,301
	LaSalle	5,343	17,231	10,153	8,732	20,355	23,038	8,616
	Pt. Coupee	17,360	67,146	36,391	43,046	135,243	89,423	10,004
	Rapides	30,288	80,898	60,471	44,077	132,622	127,565	368,231
	St. Landry	118,734	180,001	111,898	123,717	388,142	281,249	112,374
	W. B. Rouge	7,742	9,010	5,502	7,598	34,418	21,857	719
District 5 total		253,852	672,499	432,932	435,286	1,323,292	999,349	749,453
6	E. B. Rouge	23,798	54,020	27,533	28,351	92,546	77,951	28,586
	E. Feliciana	15,028	38,786	21,862	19,502	66,547	55,716	12,500
	Livingston	10,498	30,366	22,997	24,125	74,085	62,083	108,882
	St. Helena	7,625	21,401	14,604	18,026	58,099	52,885	10,046
	St. Tammany	11,151	32,229	17,093	17,524	78,990	60,192	36,991
	Tangipahoa	20,061	60,987	37,824	40,437	137,659	130,735	163,453
	Washington	15,026	57,626	36,288	45,463	131,583	108,224	13,033
	W. Feliciana	10,455	22,887	11,732	14,533	56,015	26,758	2,015
District 6 total		113,642	318,302	189,933	207,961	695,524	574,544	375,506

(Continued)

Table 34.—The value in dollars of chickens raised on farms, by parishes, 1910-1954—Continued

Dist- rict	Parish	Agricultural census year 1910	1930	1935	1940	1945	1950	1954
					Dollars			
7	Acadia	54,091	130,099	85,352	84,884	221,705	163,951	9,810
	Allen	---	27,169	16,796	19,808	34,927	52,453	17,917
	Beauregard	---	34,198	26,059	41,250	80,672	81,524	12,402
	Calcasieu	53,530	47,876	32,715	39,552	90,197	97,591	23,056
	Cameron	7,662	24,200	14,703	18,527	43,002	25,444	503
	Jeff Davis	---	50,365	32,787	33,024	62,169	68,168	47,207
	Vermilion	52,387	142,297	92,493	88,617	203,139	156,883	21,575
District 7 total		167,670	456,204	300,905	325,662	735,811	646,014	132,470
8	Assumption	6,871	21,258	13,212	22,904	55,436	46,141	11,055
	Iberia	31,673	49,723	24,557	33,769	97,065	57,878	4,176
	Iberville	8,327	17,346	12,519	19,066	38,021	37,976	7,425
	Lafayette	59,498	101,172	58,976	64,613	160,776	126,052	26,209
	St. Martin	32,550	56,044	37,362	47,290	148,398	100,995	49,338
	St. Mary	15,906	21,754	9,520	10,017	35,662	32,170	3,776
District 8 total		154,825	267,297	156,146	197,659	535,358	401,212	101,979
9	Ascension	17,984	34,931	17,630	26,185	90,800	60,501	2,070
	Jefferson	3,747	6,728	4,556	5,089	29,819	17,219	3,311
	Lafourche	25,492	57,262	33,958	40,170	130,094	80,309	8,201
	Orleans	8,998	2,501	2,697	1,592	9,259	5,628	---
	Plaquemines	7,839	10,590	2,045	5,470	28,957	14,281	2,830
	St. Bernard	1,940	1,842	3,055	1,047	8,248	7,343	1,111
	St. Charles	5,150	7,184	4,784	6,493	20,065	18,722	5,108
	St. James	6,852	13,656	9,441	11,267	27,253	32,188	8,936
	St. John	4,404	4,839	5,349	3,014	22,572	9,085	26,056
	Terrebonne	10,983	30,482	20,679	25,231	84,668	55,158	3,521
District 9 total		93,389	170,015	104,194	125,558	451,735	300,434	61,144
State total		1,158,135	2,948,298	1,948,949	2,002,737	5,462,868	4,240,875	5,688,589

Table 35.--The value in dollars of chicken eggs produced on farms, by parishes, 1930, 1950, and 1954

District	Parish	Agricultural census year		
		1930	1950	1954
		Dollars		
1	Bossier	30,513	16,670	39,709
	Caddo	34,794	72,899	125,342
	DeSoto	29,549	33,987	74,376
	Red River	6,359	24,982	122,248
	Webster	35,564	30,421	72,287
District 1 total		136,779	178,959	433,962
2	Bienville	24,661	38,780	34,592
	Caldwell	16,777	9,463	22,770
	Claiborne	23,991	34,818	47,601
	Jackson	32,746	13,798	31,632
	Lincoln	46,617	65,361	123,084
	Ouachita	22,279	39,053	60,739
	Union	45,665	53,512	54,683
	Winn	22,591	19,043	12,126
District 2 total		235,327	273,828	387,227
3	E. Carroll	7,446	11,317	19,989
	Franklin	39,341	44,287	50,473
	Madison	5,855	19,098	11,646
	Morehouse	18,262	19,491	25,148
	Richland	18,133	29,887	26,513
	Tensas	3,022	6,330	23,982
	W. Carroll	23,466	19,570	27,038
District 3 total		115,525	149,980	184,789
4	Natchitoches	35,507	38,655	34,329
	Sabine	33,953	27,055	18,895
	Vernon	27,586	41,925	62,148
District 4 total		97,046	107,635	115,372
5	Avoyelles	106,276	80,406	67,770
	Catahoula	22,934	22,444	20,376
	Concordia	5,071	11,091	7,360
	Evangeline	155,758	85,759	35,148
	Grant	22,580	15,395	62,771
	LaSalle	13,026	10,361	22,005
	Pt. Coupee	54,525	57,877	65,413
	Rapides	78,524	87,040	142,979
	St. Landry	229,460	108,488	86,214
	W. B. Rouge	6,440	10,338	5,112
District 5 total		694,594	489,199	515,148

(Continued)

Table 35.--The value in dollars of chicken eggs produced on farms, by parishes, 1930, 1950, and 1954--Continued

District	Parish	Agricultural census year		
		1930	1950	1954
		Dollars		
6	E. B. Rouge	56,053	61,546	57,130
	E. Feliciana	44,501	45,013	40,239
	Livingston	30,478	32,183	242,749
	St. Helena	17,295	36,013	58,566
	St. Tammany	39,908	48,932	175,782
	Tangipahoa	40,617	80,468	466,292
	Washington	66,845	78,432	80,111
	W. Feliciana	28,228	9,557	14,056
District 6 total		323,925	392,144	1,134,925
7	Acadia	128,755	85,856	59,108
	Allen	25,858	21,214	74,173
	Beauregard	38,396	109,844	85,361
	Calcasieu	53,593	87,878	56,822
	Cameron	28,044	9,347	9,243
	Jeff Davis	44,078	31,697	33,021
	Vermilion	241,664	93,979	114,927
District 7 total		560,388	439,815	432,655
8	Assumption	33,350	29,284	62,576
	Iberia	67,246	26,731	27,265
	Iberville	17,473	19,558	37,174
	Lafayette	128,953	52,733	126,015
	St. Martin	68,224	48,969	32,519
	St. Mary	24,009	16,616	19,046
District 8 total		339,255	193,891	304,595
9	Ascension	51,317	30,063	22,828
	Jefferson	8,742	16,025	19,754
	Lafourche	64,205	23,492	39,286
	Orleans	2,542	7,291	100
	Plaquemines	13,470	3,859	14,957
	St. Bernard	2,492	8,711	6,330
	St. Charles	6,168	16,333	25,062
	St. James	16,205	9,903	48,487
	St. John	8,299	3,517	8,345
	Terrebonne	43,893	27,236	21,173
District 9 total		217,333	146,430	206,322
State total		2,720,172	2,371,881	3,714,995

Table 36.--The value in dollars of chickens and eggs produced on farms, by parishes, 1910, 1920, 1950, and 1954

District	Parish	Agricultural census year			
		1910	1920	1950	1954
		Dollars			
1	Bossier	63,474	121,696	26,640	192,756
	Caddo	94,126	163,750	114,780	177,327
	DeSoto	78,160	191,715	62,345	293,667
	Red River	34,938	56,568	35,489	182,968
	Webster	69,226	71,545	50,313	187,208
District 1 total		339,924	605,274	289,567	1,033,926
2	Bienville	84,069	116,799	59,003	206,661
	Caldwell	34,344	58,401	16,577	28,352
	Claiborne	89,533	234,704	59,056	75,181
	Jackson	38,044	99,668	27,462	351,853
	Lincoln	95,906	120,919	165,601	796,853
	Ouachita	50,066	112,373	64,329	261,665
	Union	78,853	131,630	94,370	770,274
	Winn	46,869	87,382	30,544	74,591
District 2 total		517,684	961,876	516,942	2,565,430
3	E. Carroll	20,073	84,107	24,391	66,014
	Franklin	46,764	186,519	65,056	240,786
	Madison	19,548	52,173	29,585	26,708
	Morehouse	34,361	146,312	29,891	63,839
	Richland	38,799	117,875	51,983	67,940
	Tensas	19,985	43,867	16,439	30,953
	W. Carroll	17,031	67,406	31,019	80,262
District 3 total		196,561	698,259	248,364	576,502
4	Natchitoches	77,831	158,095	58,253	776,296
	Sabine	69,584	109,302	47,931	518,903
	Vernon	43,107	75,451	68,835	112,254
District 4 total		190,522	342,848	175,019	1,407,453
5	Avoyelles	191,750	285,550	101,539	194,790
	Catahoula	27,579	42,591	32,257	32,136
	Concordia	21,621	84,350	16,054	31,875
	Evangeline	---	374,962	120,719	73,799
	Grant	41,463	71,558	30,813	133,758
	LaSalle	28,193	37,371	19,290	31,242
	Pt. Coupee	59,436	184,984	83,673	79,705
	Rapides	74,353	262,456	140,223	531,562
	St. Landry	303,274	289,881	148,887	208,327
	W. B. Rouge	20,602	20,172	14,455	6,682
District 5 total		768,271	1,653,875	707,910	1,323,876

(Continued)

Table 36.—The value in dollars of chickens and eggs produced on farms, by parishes, 1910, 1920, 1950, and 1954--Continued

Dist-rict	Parish	Agricultural census year			
		1910	1920	1950	1954
		Dollars			
6	E. B. Rouge	70,418	111,131	122,287	88,283
	E. Feliciana	50,924	90,363	65,359	57,855
	Livingston	38,693	59,633	51,998	352,450
	St. Helena	26,967	58,082	43,532	69,816
	St. Tammany	26,877	86,880	127,347	221,155
	Tangipahoa	65,540	81,042	124,775	632,669
	Washington	50,919	104,653	118,986	95,798
	W. Feliciana	24,374	55,635	15,681	16,381
District 6 total		354,712	647,419	669,965	1,534,407
7	Acadia	171,810	246,172	128,601	86,871
	Allen	---	63,403	38,509	94,513
	Beauregard	---	61,011	148,017	101,279
	Calcasieu	184,246	74,278	130,940	91,764
	Cameron	22,699	23,887	16,620	24,023
	Jeff Davis	---	115,585	68,699	90,817
	Vermilion	156,937	353,059	142,027	158,142
District 7 total		535,692	937,395	673,413	647,409
8	Assumption	24,320	31,404	39,789	73,687
	Iberia	92,082	173,399	50,900	34,703
	Iberville	21,916	52,511	25,856	46,052
	Lafayette	186,672	268,095	79,573	156,170
	St. Martin	109,357	218,899	73,426	82,849
	St. Mary	35,316	27,426	26,590	23,165
District 8 total		469,663	771,734	296,134	416,626
9	Ascension	43,097	139,143	40,640	25,948
	Jefferson	8,877	16,732	36,200	23,984
	Lafourche	98,013	109,631	38,099	48,038
	Orleans	39,571	48,626	63,567	500
	Plaquemines	17,539	21,263	9,223	18,097
	St. Bernard	8,797	3,178	18,079	7,469
	St. Charles	3,747	16,319	47,212	30,500
	St. James	15,612	11,432	13,522	58,123
	St. John	6,311	7,987	36,635	36,504
	Terrebonne	31,234	65,673	41,895	25,399
District 9 total		272,798	439,984	345,072	274,562
State total		3,645,827	7,058,664	3,922,386	9,780,191

Table 37.--Receipts from sale of poultry and eggs, by parishes, 1910-1954

District	Parish	Agricultural census year					
		1910	1920	1940	1945	1950	1954
		Dollars					
1	Bossier	11,342	13,421	21,712	34,046	23,828	78,582
	Caddo	25,667	23,875	45,594	105,521	99,094	170,595
	DeSoto	16,436	25,027	30,489	30,771	58,788	289,989
	Red River	9,345	3,785	19,261	40,632	34,762	180,960
	Webster	23,757	16,952	31,449	50,968	47,987	184,724
District 1 total		86,547	83,060	148,505	261,938	264,459	904,850
2	Bienville	21,793	18,071	22,144	39,532	56,732	204,544
	Caldwell	12,154	16,086	10,434	38,080	14,989	26,929
	Claiborne	16,358	32,239	25,654	74,581	57,275	73,250
	Jackson	15,555	19,912	26,704	95,180	22,807	347,524
	Lincoln	33,442	33,421	31,448	49,627	160,468	793,990
	Ouachita	15,139	19,866	30,552	57,614	56,636	247,484
	Union	25,980	35,966	61,608	113,552	90,880	769,261
	Winn	19,711	20,931	19,647	37,999	29,886	73,652
District 2 total		160,132	196,492	228,191	506,165	489,673	2,536,634
3	E. Carroll	3,234	5,916	9,804	12,441	20,456	63,093
	Franklin	8,316	23,973	38,263	64,060	61,843	237,352
	Madison	4,356	8,726	13,598	16,875	27,447	24,448
	Morehouse	4,443	15,947	9,305	35,674	28,011	60,751
	Richland	5,474	24,825	28,924	41,973	40,950	62,175
	Tensas	4,380	2,736	6,360	5,636	12,621	28,330
	W. Carroll	4,121	8,750	29,505	48,913	30,068	77,678
District 3 total		34,324	90,873	135,759	225,572	221,396	553,827

(Continued)

Table 37.--Receipts from sale of poultry and eggs, by parishes, 1910-1954--Continued

District	Parish	Agricultural census year 1910	1920	1940	1945	1950	1954
		Dollars					
4	Natchitoches	15,936	24,139	26,378	39,683	55,918	768,450
	Sabine	25,965	32,951	21,632	48,724	46,479	515,671
	Vernon	18,466	25,835	30,362	85,639	65,783	109,955
District 4 total		60,367	82,925	78,372	174,046	168,180	1,394,076
5	Avoyelles	51,237	66,352	42,679	259,505	94,536	184,769
	Catahoula	7,306	11,096	9,461	102,804	31,417	30,967
	Concordia	5,202	6,234	10,099	14,158	15,933	30,682
	Evangeline	---	208,697	107,812	153,099	110,955	66,444
	Grant	12,661	16,241	17,172	38,161	28,053	130,072
	LaSalle	9,651	12,823	7,913	13,976	16,993	30,621
	Pt. Coupee	5,100	24,098	38,429	119,522	79,096	75,417
	Rapides	20,777	72,314	48,284	112,015	127,855	511,210
	St. Landry	146,496	114,891	133,385	313,079	141,088	198,588
	W. B. Rouge	2,564	2,216	2,898	1,786	13,607	5,831
District 5 total		260,994	534,962	418,132	1,128,105	659,533	1,264,601
6	E. B. Rouge	25,763	52,228	45,802	122,548	111,032	85,716
	E. Feliciana	12,380	30,954	16,455	59,279	61,398	52,739
	Livingston	20,596	26,761	29,829	83,329	43,234	351,631
	St. Helena	9,860	22,778	14,490	73,539	43,006	68,612
	St. Tammany	12,453	25,320	42,300	169,277	117,092	212,773
	Tangipahoa	20,461	27,439	31,390	135,430	119,077	629,745
	Washington	22,538	46,024	64,869	246,561	115,734	93,144
	W. Feliciana	7,040	18,164	18,654	60,083	12,214	16,071
District 6 total		131,091	249,668	263,789	950,046	622,787	1,510,431

(Continued)

Table 37.--Receipts from sale of poultry and eggs, by parishes, 1910-1954--Continued

Dist-: rict :	Parish	Agricultural census year 1910	1920	1940	1945	1950	1954
		- - - - - - - -	- - - - - - - -	- - - - - - Dollars	- - - - - - - -	- - - - - - - -	- - - - - - - -
7	Acadia	90,814	121,598	84,039	100,570	114,080	68,918
	Allen	---	16,668	20,057	27,760	36,782	92,090
	Beauregard	---	24,695	100,840	187,867	142,206	97,763
	Calcasieu	72,192	26,379	72,873	74,837	115,828	79,878
	Cameron	6,956	9,548	17,373	11,335	10,985	9,746
	Jeff Davis	---	35,167	29,336	20,849	57,075	80,228
	Vermilion	87,281	216,001	114,416	149,199	120,021	136,502
District 7 total		257,243	450,056	438,934	572,417	596,977	565,125
8	Assumption	8,087	7,192	22,557	30,979	38,574	73,631
	Iberia	25,594	44,908	33,336	42,250	48,217	31,441
	Iberville	2,984	9,070	10,643	20,834	24,659	44,599
	Lafayette	94,657	130,007	58,774	97,664	75,793	152,224
	St. Martin	34,771	70,506	27,854	42,610	72,049	81,857
	St. Mary	4,039	5,988	9,391	13,718	24,910	22,822
District 8 total		170,132	267,671	162,555	248,055	284,202	406,574
9	Ascension	21,893	91,247	30,217	64,265	38,650	24,898
	Jefferson	4,567	7,697	21,487	45,385	33,931	23,065
	Lafourche	36,211	43,237	23,716	35,827	37,590	47,487
	Orleans	17,356	37,010	9,144	177,753	62,621	100
	Plaquemines	1,336	2,102	2,844	8,252	9,017	17,787
	St. Bernard	722	238	1,093	1,135	17,597	7,441
	St. Charles	823	3,253	10,514	42,878	45,961	30,170
	St. James	474	732	4,745	1,480	12,729	57,423
	St. John	783	1,611	1,675	35,881	36,246	34,401
	Terrebonne	9,369	26,354	26,120	22,085	41,111	24,694
District 9 total		93,534	213,481	131,555	434,941	335,453	267,466
State total		1,254,364	2,169,108	2,005,792	4,501,285	3,642,660	9,403,584

Table 38.--Number of chickens raised on farms, by parishes, 1910-1954

District	Parish	1910	1920	1930	1935	1940	1945	1950	1954
		Number							
1	Bossier	105,765	73,055	140,202	113,322	122,114	121,389	44,863	47,253
	Caddo	151,981	90,782	222,443	151,245	201,888	205,544	81,286	75,553
	DeSoto	147,188	163,078	152,441	123,690	180,728	155,854	62,637	57,772
	Red River	63,924	43,128	78,812	71,001	79,348	64,226	42,012	52,855
	Webster	108,297	45,433	137,487	120,277	147,887	132,221	51,243	51,342
District 1 total		582,155	415,476	731,385	579,535	731,965	679,234	282,041	284,775
2	Bienville	141,316	71,830	131,387	98,005	119,233	121,091	59,779	39,774
	Caldwell	54,220	26,536	46,625	44,663	54,725	66,700	30,970	33,087
	Claiborne	183,887	157,006	178,644	158,835	168,812	173,462	70,678	53,155
	Jackson	58,626	37,125	62,410	50,218	73,851	71,269	24,301	29,190
	Lincoln	120,374	61,997	144,177	101,444	137,036	108,731	55,140	58,082
	Ouachita	76,790	67,264	116,546	94,494	107,714	109,885	47,020	42,950
	Union	142,263	82,274	146,007	127,982	184,641	164,776	58,581	57,843
	Winn	60,033	34,093	59,406	56,763	67,934	79,291	32,904	28,532
District 2 total		837,509	538,125	885,202	732,404	913,946	895,205	379,373	342,613
3	E. Carroll	24,858	42,918	70,821	82,284	94,207	96,564	41,656	33,631
	Franklin	84,556	99,036	194,483	210,575	232,939	305,449	110,929	96,622
	Madison	29,754	64,158	61,172	60,840	92,872	100,207	41,339	29,700
	Morehouse	68,271	92,483	117,919	104,080	118,348	200,613	64,747	53,518
	Richland	74,468	84,393	162,303	158,692	210,629	195,567	80,884	69,029
	Tensas	40,361	38,093	42,425	58,083	64,630	82,024	31,502	27,742
	W. Carroll	24,828	51,308	81,242	93,145	147,155	173.409	73,333	64,363
District 3 total		347,096	472,389	730,365	767,699	960,780	1,153,833	444,390	374,605

(Continued)

Table 38.--Number of chickens raised on farms, by parishes, 1910-1954--Continued

Dist-rict	Parish	Agricultural census year 1910	1920	1930	1935	1940	1945	1950	1954
		Number							
4	Natchitoches	129,265	83,226	208,807	153,809	178,584	146,987	82,719	73,848
	Sabine	99,659	56,728	106,017	80,815	101,767	98,879	48,098	42,493
	Vernon	58,586	26,110	89,946	71,743	94,603	123,446	62,007	57,811
District 4 total		287,510	166,064	404,770	306,367	374,954	369,312	192,824	174,152
5	Avoyelles	291,720	189,870	345,446	360,163	279,021	491,113	169,193	148,979
	Catahoula	45,203	22,352	72,077	70,738	71,092	105,673	47,290	42,981
	Concordia	52,013	48,205	38,603	37,704	51,878	53,562	33,080	23,554
	Evangeline	---	143,341	328,656	244,413	275,889	329,662	136,336	105,509
	Grant	63,839	26,481	80,976	66,166	61,428	96,586	28,844	42,261
	LaSalle	37,643	16,590	40,594	29,767	33,474	31,745	20,944	19,845
	Pt. Coupee	121,795	118,362	170,938	125,753	208,091	202,612	81,294	74,065
	Rapides	131,679	145,353	207,337	195,620	154,902	233,713	115,968	115,342
	St. Landry	403,585	151,799	414,593	408,127	520,637	675,083	255,681	221,276
	W. B. Rouge	42,515	11,862	22,410	13,980	22,168	44,912	19,870	13,408
District 5 total		1,189,992	874,215	1,721,630	1,552,431	1,678,580	2,264,661	908,500	807,220
6	E. B. Rouge	92,884	45,515	127,990	85,888	105,526	168,382	66,060	44,200
	E. Feliciana	94,006	61,849	99,792	59,563	71,242	111,022	47,217	41,184
	Livingston	39,635	20,896	67,884	73,284	81,692	116,351	52,613	92,932
	St. Helena	43,478	32,738	51,171	42,712	63,558	80,956	44,818	43,747
	St. Tammany	28,953	23,242	84,668	59,328	88,228	157,139	51,010	67,021
	Tangipahoa	65,403	32,321	121,749	137,951	120,593	239,908	110,792	160,571
	Washington	67,852	52,067	131,111	106,729	147,998	181,694	91,715	75,095
	W. Feliciana	48,805	47,751	64,671	32,914	57,059	86,429	22,676	18,622
District 6 total		481,016	316,379	749,036	598,369	735,896	1,141,881	486,901	543,372

(Continued)

Dist-rict	Parish	Agricultural census year 1910	1920	1930	1935	1940	1945	1950	1954
		Number							
7	Acadia	217,778	94,573	252,621	266,536	271,900	282,664	128,087	119,848
	Allen	---	20,980	67,275	51,168	66,077	50,352	40,979	51,624
	Beauregard	---	25,640	88,007	87,454	114,484	115,418	63,691	54,884
	Calcasieu	171,286	28,747	128,535	127,781	158,603	147,325	76,243	42,291
	Cameron	42,923	12,796	63,384	44,604	73,849	66,348	19,878	14,215
	Jeff Davis	---	31,108	124,049	113,156	120,713	106,867	53,256	41,838
	Vermilion	230,682	125,783	311,820	305,140	309,549	316,800	122,565	109,032
District 7 total		662,669	339,627	1,035,691	995,839	1,115,175	1,085,774	504,699	433,732
8	Assumption	18,388	13,251	38,508	29,479	60,046	64,501	35,768	28,498
	Iberia	129,574	76,773	137,789	82,986	122,815	139,557	44,867	43,968
	Iberville	39,510	32,198	36,763	32,643	42,560	53,629	29,439	30,157
	Lafayette	168,316	129,758	235,508	220,870	245,478	300,236	97,715	113,867
	St. Martin	154,601	134,804	149,582	163,955	200,862	219,013	78,291	83,540
	St. Mary	47,534	9,784	43,258	37,636	31,342	47,287	24,938	20,553
District 8 total		557,923	396,568	641,408	567,569	703,103	824,223	311,018	320,583
9	Ascension	52,376	60,090	68,456	64,685	77,367	139,265	43,526	37,813
	Jefferson	9,859	3,416	15,199	14,172	58,342	46,661	12,388	8,754
	Lafourche	109,059	45,369	98,062	122,250	101,232	134,943	57,776	40,821
	Orleans	26,605	5,750	4,611	9,420	4,762	11,110	4,049	463
	Plaquemines	25,131	20,404	78,538	8,760	25,000	53,476	10,274	9,466
	St. Bernard	7,939	2,415	4,486	9,506	2,810	20,302	5,283	4,534
	St. Charles	6,726	7,581	13,323	15,386	17,620	48,919	13,469	8,733
	St. James	20,887	7,428	32,849	48,805	41,073	34,408	23,157	23,460
	St. John	8,762	6,347	11,685	15,878	9,980	57,134	6,536	5,415
	Terrebonne	42,009	21,093	52,472	77,458	74,572	110,434	39,682	26,329
District 9 total		309,353	179,893	379,681	386,320	412,758	656,652	216,140	165,788
State total		5,255,223	3,698,736	7,279,168	6,486,533	7,627,157	9,070,775	3,725,886	3,446,840

Table 39.--Number of dozens of chicken eggs produced on farms, by parishes, 1910-1954

Dist-rict	Parish	Agricultural census year							
		1910	1920	1930	1935	1940	1945	1950	1954
		Number							
1	Bossier	203,689	166,999	109,865	166,414	294,765	315,178	36,505	83,025
	Caddo	254,971	224,688	180,576	255,025	492,654	607,799	156,249	276,305
	DeSoto	236,065	212,689	129,595	189,939	427,074	443,513	68,378	148,391
	Red River	102,286	96,924	62,425	110,752	257,797	181,784	53,769	262,618
	Webster	235,176	131,722	123,000	242,201	346,342	301,003	65,276	154,217
District 1 total		1,032,187	833,022	605,461	964,331	1,818,632	1,849,277	380,177	924,556
2	Bienville	281,567	193,367	113,664	208,013	421,130	416,983	92,226	71,393
	Caldwell	119,675	89,910	49,955	113,897	179,596	217,345	26,355	46,581
	Claiborne	293,130	300,880	139,591	348,145	413,187	524,036	78,725	100,390
	Jackson	151,781	227,774	71,702	133,389	216,886	422,718	32,209	72,016
	Lincoln	381,223	225,031	137,388	319,780	363,231	250,556	138,701	272,129
	Ouachita	147,070	145,326	103,225	201,066	280,245	288,832	82,590	122,001
	Union	304,019	202,328	132,283	289,658	521,157	599,741	130,771	126,004
	Winn	178,116	162,203	60,601	215,426	246,166	332,653	42,227	22,612
District 2 total		1,856,581	1,546,819	808,409	1,829,374	2,641,598	3,052,864	623,804	833,126
3	E. Carroll	53,047	126,977	52,881	148,963	324,519	320,100	27,210	47,694
	Franklin	146,115	319,417	174,696	408,775	637,270	879,754	125,420	119,758
	Madison	47,199	81,244	58,386	135,734	193,957	232,505	44,569	27,472
	Morehouse	80,203	189,599	90,641	151,214	267,873	397,581	42,574	56,902
	Richland	110,571	237,125	108,301	245,366	517,875	474,978	77,897	63,503
	Tensas	46,458	50,317	25,359	110,046	147,983	173,775	13,779	62,529
	W. Carroll	51,832	124,064	89,297	204,565	525,269	559,920	57,081	67,975
District 3 total		535,425	1,128,743	599,561	1,404,663	2,614,746	3,038,613	388,530	445,833

(Continued)

Table 39.--Number of dozens of chicken eggs produced on farms, by parishes, 1910-1954--Continued

Dist-rict	Parish	Agricultural census year							
		1910	1920	1930	1935	1940	1945	1950	1954
		Number							
4	Natchitoches	265,014	260,540	127,199	263,230	481,937	467,710	96,062	72,503
	Sabine	242,727	216,664	97,959	273,285	386,765	383,212	71,954	51,160
	Vernon	113,243	108,777	72,630	195,727	377,008	500,606	111,228	149,859
District 4 total		620,984	585,981	297,788	732,242	1,245,710	1,351,528	279,244	273,522
5	Avoyelles	697,269	376,536	226,029	666,686	868,759	1,406,226	230,814	170,472
	Catahoula	94,879	93,539	65,787	197,113	219,030	370,466	53,719	49,446
	Concordia	43,957	118,726	32,004	87,326	144,451	166,193	23,656	16,074
	Evangeline	---	701,278	266,072	539,296	994,488	1,117,890	260,976	99,352
	Grant	144,163	119,900	74,874	176,728	187,553	295,150	35,182	150,014
	LaSalle	91,875	63,760	40,312	63,412	114,050	141,202	24,777	43,669
	Pt. Coupee	167,884	264,203	123,505	168,586	463,884	690,855	137,655	164,896
	Rapides	186,433	301,068	167,463	456,248	576,745	635,322	200,301	344,029
	St. Landry	1,136,449	566,852	379,341	635,642	1,549,848	2,097,592	317,246	221,513
	W. B. Rouge	39,846	38,669	16,855	31,894	56,776	148,071	21,700	11,595
District 5 total		2,602,755	2,644,531	1,392,242	3,022,931	5,175,589	7,068,967	1,306,026	1,271,060
6	E. B. Rouge	178,136	182,251	111,923	206,244	321,099	434,897	130,390	129,373
	E. Feliciana	142,043	173,001	86,601	153,345	203,339	402,945	94,983	92,420
	Livingston	142,586	118,615	70,204	206,418	269,162	425,769	71,918	416,141
	St. Helena	82,293	102,118	39,994	81,126	163,843	266,272	79,245	129,396
	St. Tammany	61,794	151,984	75,485	148,815	153,419	383,047	101,604	374,458
	Tangipahoa	184,698	139,844	132,093	287,890	379,060	675,155	182,768	942,464
	Washington	142,603	183,675	123,078	248,387	502,234	763,896	196,265	172,820
	W. Feliciana	66,139	91,899	54,053	67,784	113,463	290,957	22,869	37,289
District 6 total		1,000,292	1,143,387	693,431	1,400,009	2,105,619	3,642,938	880,042	2,294,361

(Continued)

Table 39.--Number of dozens of chicken eggs produced on farms, by parishes, 1910-1954--Continued

Dist-rict	Parish	Agricultural census year 1910	1920	1930	1935	1940	1945	1950	1954
		- - - - - - - -	- - - - - - - -	- - - - - - - -	- - - - - - - -	Number	- - - - - - - -	- - - - - - - -	- - - - - - - -
7	Acadia	718,146	556,831	223,295	750,667	1,012,841	821,788	254,306	147,551
	Allen	---	89,575	56,215	134,948	229,907	218,020	54,902	186,634
	Beauregard	---	86,369	82,337	386,372	591,554	574,559	258,062	209,355
	Calcasieu	533,414	116,661	103,805	345,028	510,743	536,227	199,989	126,691
	Cameron	88,162	47,571	46,203	142,031	167,612	147,278	27,702	21,122
	Jeff Davis	---	210,415	95,778	250,886	357,082	317,209	92,821	77,037
	Vermilion	760,866	775,144	358,750	758,069	1,035,094	952.819	276,690	259,934
District 7 total		2,100,588	1,882,566	966,383	2,768,001	3,904,833	3,567,900	1,164,472	1,028,324
8	Assumption	87,877	73,519	54,891	100,899	264,746	151,199	73,216	131,327
	Iberia	290,003	236,592	108,062	265,694	342,133	360,719	67,357	73,021
	Iberville	67,813	89,847	36,992	55,554	126,341	166,630	45,912	95,313
	Lafayette	746,329	541,096	195,335	433,076	686,348	692,506	158,056	303,636
	St. Martin	355,752	291,673	105,484	151,171	457,622	447,786	139,549	85,725
	St. Mary	80,516	51,384	46,973	98,427	78,883	99,828	37,808	47,941
District 8 total		1,628,290	1,284,111	547,737	1,104,821	1,956,073	1,918,668	521,898	736,963
9	Ascension	139,879	252,318	79,630	133,957	296,434	337,126	72,274	56,177
	Jefferson	12,717	26,958	16,989	56,598	48,729	166,393	32,088	39,145
	Lafourche	350,618	208,235	103,866	179,122	345,431	456,981	56,921	88,246
	Orleans	81,138	77,446	5,520	27,882	38,896	30,901	14,421	350
	Plaquemines	35,243	19,014	25,785	14,236	43,628	98,536	7,581	30,791
	St. Bernard	20,364	4,319	4,296	27,846	6,479	21,620	15,679	14,901
	St. Charles	6,115	18,995	15,787	33,288	62,804	109,751	34,776	51,679
	St. James	42,210	17,314	29,179	98,494	80,517	90,844	21,336	102,779
	St. John	16,216	13,019	13,433	45,911	20,801	77,427	7,426	18,315
	Terrebonne	95,123	145,512	66,550	163,639	224,002	288,150	61,734	42,195
District 9 total		799,623	783,130	361,035	780,973	1,167,721	1,677,729	324,236	444,578
State total		12,176,725	11,832,290	6,272,047	14,007,345	22,630,521	27,168,484	5,868,429	8,252,323

Table 40.--The value in dollars of chickens (4 months old and older) on farms, by parishes, 1925-1950

District	Parish	Agricultural census year				
		1925	1930	1940	1945	1950
		Dollars				
1	Bossier	37,674	49,856	29,828	68,228	47,555
	Caddo	51,883	80,804	45,694	104,168	86,163
	DeSoto	55,391	54,740	41,584	86,014	66,395
	Red River	22,622	32,605	23,259	43,379	44,533
	Webster	41,468	52,850	30,969	66,396	54,318
District 1 total		209,038	270,855	171,334	368,185	298,964
2	Bienville	44,748	49,567	32,751	72,285	62,170
	Caldwell	20,896	20,878	14,334	41,452	32,209
	Claiborne	56,516	59,736	33,989	83,233	73,505
	Jackson	26,848	28,614	18,415	47,546	25,273
	Lincoln	42,059	53,798	30,459	65,970	57,346
	Ouachita	29,878	46,063	23,403	64,950	48,901
	Union	68,996	56,796	41,508	100,412	60,924
	Winn	31,930	27,475	18,508	47,388	34,220
District 2 total		321,871	342,927	213,367	523,236	394,548
3	E. Carroll	14,642	29,620	23,617	53,350	40,406
	Franklin	61,573	79,230	57,292	159,950	107,601
	Madison	30,429	25,414	21,396	61,883	40,099
	Morehouse	36,168	47,062	27,965	81,913	62,805
	Richland	48,254	58,113	46,083	111,312	78,457
	Tensas	18,418	18,071	16,110	52,931	30,557
	W. Carroll	20,186	33,226	37,564	93,320	71,133
District 3 total		229,670	290,736	230,027	614,659	431,058
4	Natchitoches	72,207	76,954	44,649	94,554	83,546
	Sabine	55,092	47,698	28,483	56,506	48,579
	Vernon	44,213	34,811	22,751	64,008	62,627
District 4 total		171,512	159,463	95,883	215,068	194,752
5	Avoyelles	91,522	116,517	76,954	255,380	186,112
	Catahoula	25,030	31,332	23,951	76,178	52,019
	Concordia	20,659	17,076	15,169	40,899	36,388
	Evangeline	104,082	123,085	77,124	189,154	149,970
	Grant	22,277	30,203	14,918	50,901	31,728
	LaSalle	18,585	17,231	8,732	20,355	23,038
	Pt. Coupee	56,353	67,146	43,046	135,243	89,423
	Rapides	76,484	80,898	44,077	132,622	127,565
	St. Landry	147,032	180,001	123,717	388,142	281,249
	W. B. Rouge	9,045	9,010	7,598	34,418	21,857
District 5 total		571,069	672,499	435,286	1,323,292	999,349

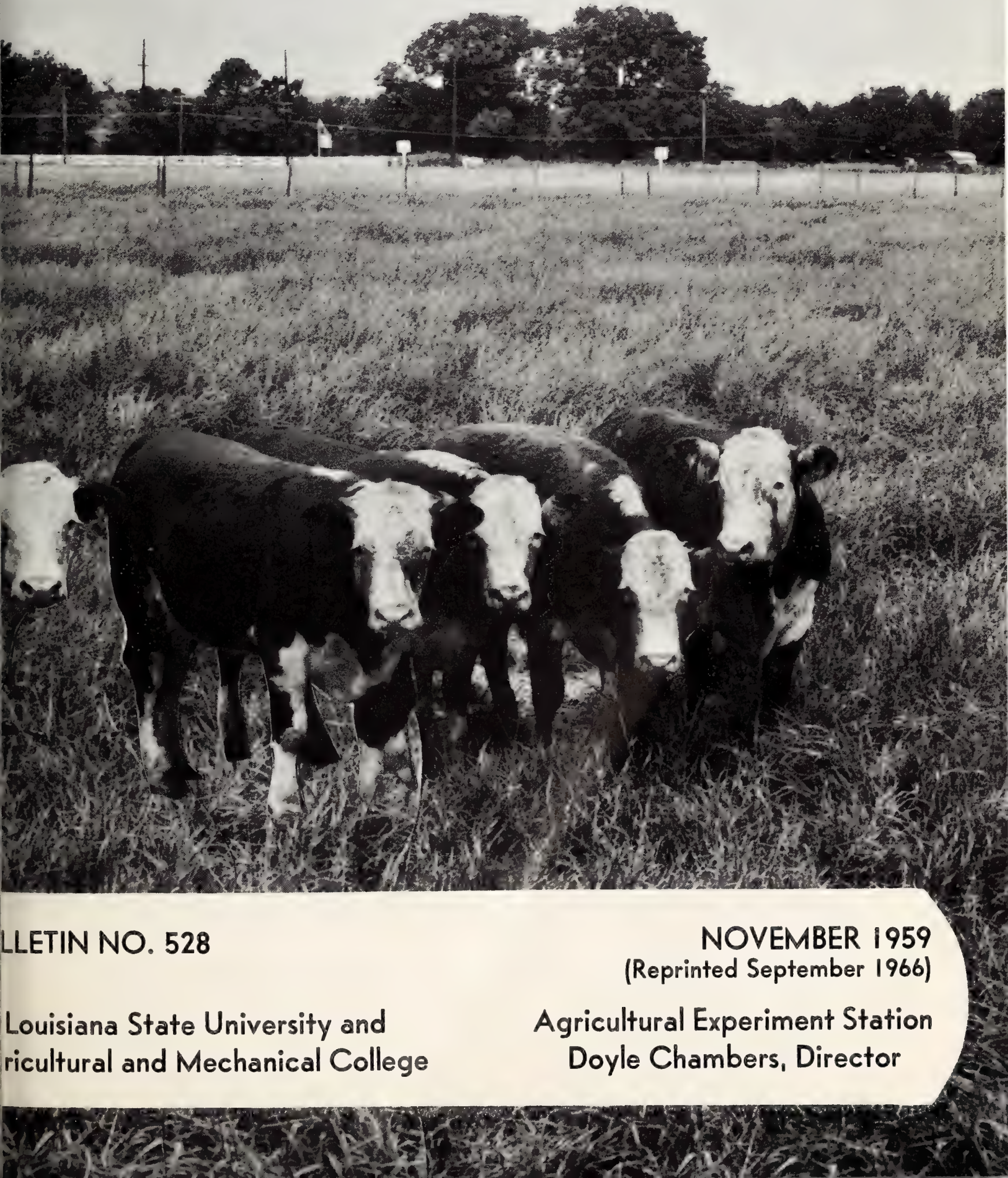
(Continued)

Table 40.--The value in dollars of chickens (4 months old and older) on farms, by parishes, 1925-1950--Continued

District	Parish	1925	1930	1940	1945	1950
		Agricultural census year				
		Dollars				
6	E. B. Rouge	38,924	54,020	28,351	92,546	77,951
	E. Feliciana	32,416	38,786	19,502	66,547	55,716
	Livingston	26,099	30,366	24,125	74,085	62,083
	St. Helena	20,576	21,401	18,026	58,099	52,885
	St. Tammany	30,372	32,229	17,524	78,990	60,192
	Tangipahoa	49,893	60,987	40,437	137,659	130,735
	Washington	42,953	57,626	45,463	131,583	108,224
	W. Feliciana	21,104	22,887	14,533	56,015	26,758
District 6 total		262,337	318,302	207,961	695,524	574,544
7	Acadia	116,939	130,099	84,884	221,705	163,951
	Allen	24,789	27,169	19,808	34,927	52,453
	Beauregard	31,380	34,198	41,250	80,672	81,524
	Calcasieu	40,059	47,876	39,552	90,197	97,591
	Cameron	18,766	24,200	18,527	43,002	25,444
	Jeff Davis	47,279	50,365	33,024	62,169	68,168
	Vermilion	145,852	142,297	88,617	203,139	156,883
District 7 total		425,064	456,204	325,662	735,811	646,014
8	Assumption	38,176	21,258	22,904	55,436	46,141
	Iberia	50,390	49,723	33,769	97,065	57,878
	Iberville	34,562	17,346	19,066	38,021	37,976
	Lafayette	121,179	101,172	64,613	160,776	126,052
	St. Martin	139,626	56,044	47,290	148,398	100,995
	St. Mary	30,973	21,754	10,017	35,662	32,170
District 8 total		414,906	267,297	197,659	535,358	401,212
9	Ascension	56,351	34,931	26,185	90,800	60,501
	Jefferson	8,580	6,728	5,089	29,819	17,219
	Lafourche	82,097	57,262	40,170	130,094	80,309
	Orleans	10,897	2,501	1,592	9,259	5,628
	Plaquemines	11,432	10,590	5,470	28,957	14,281
	St. Bernard	3,752	1,842	1,047	8,248	7,343
	St. Charles	10,294	7,184	6,493	20,065	18,722
	St. James	15,999	13,656	11,267	27,253	32,188
	St. John	10,997	4,839	3,014	22,572	9,085
	Terrebonne	40,048	30,482	25,231	84,668	55,158
District 9 total		250,447	170,015	125,558	451,735	300,434
State total		2,855,914	2,948,298	2,002,737	5,462,868	4,240,875

The Value of RYEGRASS PASTURES FOR BEEF STEERS

John C. Carpenter, Jr., Sherman A. Phillips
and Paul B. Brown



LLETIN NO. 528

NOVEMBER 1959
(Reprinted September 1966)

Louisiana State University and
ricultural and Mechanical College

Agricultural Experiment Station
Doyle Chambers, Director

CONTENTS

Page

Introduction 5
Review of Literature 6
Experimental Procedure 6

Phase I—Wintering

Experimental Procedure 7
Experimental Results 7
Discussion of Results 7

Phase II—Grazing the Ryegrass

Experimental Procedure 8
Experimental Results 8
Discussion of Results 9

Phase III—Grazing and Supplemental Feeding

Experimental Procedure 10
Experimental Results 10
Discussion of Results 10
Summary 11
General Conclusions 14
Literature Cited 14
Recommended Procedure for the Preparation and Grazing of Ryegrass Pastures on the Macon Ridge (Olivier and Richland silt loam soils) 16

ACKNOWLEDGEMENTS

The authors wish to thank Dr. George L. Robertson, Head, Animal Industry Department, Louisiana State University, for his very helpful advice in setting up these tests, R. M. Crown, Associate Professor, Animal Industry Department, Louisiana State University, A. P. Parham, Animal Husbandman, and H. E. McFatter, Associate Animal Husbandman, Louisiana Agricultural Extension Service, for their assistance in grading the animals each year and for their helpful advice on the program.

The Value of Ryegrass Pastures for Beef Steers

John C. Carpenter, Jr.,[1] Sherman A. Phillips[2] and Paul B. Brown[3]

INTRODUCTION

There has been considerable interest in Louisiana in carrying late spring calves through the winter for sale on the following spring market. Many cattlemen felt that lightweight spring calves could be sold at better advantage by holding them through the winter, provided a rapid and economical gain could be put on them.

Because of this interest, an outfield winter grazing test was initiated in 1953 by the Northeast Louisiana Experiment Station. This first test was held in cooperation with the Sweet Potato Research Center, Chase, Louisiana, and repeated in 1954. The grasses tested both years were oats, Atlas 66 wheat, and ryegrass. Abruzzi rye and prairie brome grass were tested one year. (Vetch and crimson clover were planted in all plots the first year but, because of the small amount of grazing furnished, they were not replanted the second year.) These grazing tests demonstrated that the ryegrass furnished more total pounds of beef per acre, higher daily gains, a greater carrying capacity, and more net profit than either wheat or oats. Other experiments (4, 5, 6, 7, and 10) have shown ryegrass to be superior to other winter grasses for the grazing of beef calves.

Because of the outstanding results obtained with ryegrass each year, it was selected as the grazing crop for this three-year study at the Macon Ridge Branch Experiment Station, Winnsboro, Louisiana, during 1955, 1956, and 1957. The trials reported in this publication were designed to answer the following questions:

(1) Is it profitable to buy weanling calves in the fall, graze them on ryegrass pastures through the winter and spring, then sell?

(2) Does supplemental feeding of hay on lush grass reduce scouring and/or improve rate of gain?

(3) Will additional protein and energy, such as supplied by cottonseed meal or oats, pay when fed as the ryegrass begins to mature?

---

[1] Assistant Animal Husbandman, Northeast Louisiana Experiment Station, St. Joseph, La.

[2] Assistant Agronomist, In Charge of Macon Ridge Branch Experiment Station, Winnsboro, La.

[3] Associate Professor, Animal Industry, Louisiana State University, Baton Rouge, La.

REVIEW OF LITERATURE

Gill at the Brown Loam Station (Miss.) (4, 5) found that a mixture of ryegrass and crimson clover was superior to other winter forages tested. In a three-year average, ryegrass and crimson clover had a longer grazing season and produced more beef per acre than either fescue grass, wheat, or oats. Morrison (7), reporting from the same station in 1958, found that ryegrass alone produced greater gain and greater net return in a grazing program than it did in combination with rye, wheat, or oats.

Hughes et al. (6) state: "Ryegrass makes rapid winter and spring growth. New seedings often are ready to pasture in 3 months from seeding. Heavy pasturing is generally desirable as it keeps the grass in succulent condition and utilizes a higher per cent of the forage during its short productive period. For pasturage, ryegrass is often seeded alone. The ryegrasses respond quickly to applications of nitrogen fertilizers."

Thompson (10) reports that, "Ryegrass is a hardy, short lived annual. It grows fast, is tender and livestock like it. It produces lots of grazing during the latter part of February, March and April."

In the work at the Macon Ridge Branch Station (1, 2, 3) it was found that ryegrass seeded in September or October on a well-prepared seedbed would furnish grazing beginning December to February 1 and lasting until May.

EXPERIMENTAL PROCEDURE

This study was divided into three phases as follows: Phase I—Wintering in Drylot; Phase II—Grazing the Ryegrass; Phase III—Grazing With Supplemental Feeding After the Ryegrass Started to Mature.

Preparation of Pastures: Twenty-four acres were fenced and cross fenced in the summer of 1955 to provide six pastures of 4 acres each. The plots were disked in August, prior to planting the ryegrass in October. A soil test was obtained on each plot and one ton of lime was applied per acre. Each plot was disked three times in 1955 and in 1956 prior to fertilizing and seeding. The ryegrass was not seeded in the fall of 1957 because there was ample moisture and seed left on the pasture to give a satisfactory volunteer stand. Table 1 gives the rate of seeding and amounts of fertilizer applied per acre.

Table 1.—Seeding and Fertilizer Rates

Per Acre (Lbs.)	1955	1956	1957
Ryegrass	49	40	Not Seeded
3-12-12	413	400	300
Ammonium nitrate	227	200	190
Ammonium nitrate as topdressing	100	100	150

The complete fertilizer, 3-12-12, and part of the ammonium nitrate were disked in before planting in 1955 and 1956. They were applied as a topdressing in 1957 after the ryegrass had begun to grow. Ammonium nitrate was applied as a topdressing in March of each year.

PHASE I. WINTERING

Experimental Procedure

Thirty-six medium to good grade Hereford or Angus weanling steer calves were purchased each fall (1955, 1956, and 1957) to be used in these studies. The calves purchased in 1955 were wintered at Chase, Louisiana, on dried Bermuda grass pasture plus a mixture of salt-cottonseed meal mixed 1 to 4 and fed free choice. During 1956 and 1957 the calves were wintered at St. Joseph, Louisiana, on 30 pounds of Tracy sorgo silage plus 1 pound of cottonseed meal per head per day.

Experimental Results

The results of the wintering periods are presented by years in Table 2.

Discussion of Results — Phase I

The steers in 1955 did not consume enough of the cottonseed meal-salt mixture to produce any gain because they would not come to the feeders to eat the mixture. These cattle were very excitable and spent most of their time in a large wooded area located within the Bermuda grass pasture where they were wintered. In 1956 and 1957, the steers made small gains which were considered satisfactory. As shown in Table 2, the average total cost per steer at the end of the wintering phase includes the initial cost plus wintering. Owing to the fact that in 1955 the steers lost 42 pounds per head and in 1956 gained only 6 pounds per head the average cost per hundredweight at the end of Phase I was slightly higher than the purchase price per hundredweight. In 1957

Table 2.—Wintering Data

	1955	1956	1957
Number of animals	36	36	36
Av. number of days	80	58	20
Av. final wt., lbs.	396	429	421
Av. initial wt., lbs.	438	423	404
Av. gain/steer, lbs.	—42	6	17
Av. price/cwt. bought	$16.00	$18.00	$24.00
Av. initial cost/steer	$70.08	$76.14	$96.96
Plus wintering	$ 2.08	$ 6.55	$ 2.25
Av. total cost/steer at end of Phase I	$72.16	$82.69	$99.21
Av. cost per cwt at end of Phase I	$18.22	$19.28	$23.57

the steers gained 17 pounds per head, bringing the average cost per hundredweight at the end of Phase I slightly below the purchase price per hundredweight.

PHASE II. GRAZING THE RYEGRASS

Experimental Procedure

As soon as the ryegrass pastures were ready to graze, 36 steers were divided into six lots of six steers each, comparable in weight, size, and conformation and placed on the ryegrass pastures. Bermuda grass hay was fed free choice to three lots and the remaining three lots received no hay.

In 1956 one-half of the calves in each lot were dehorned at the beginning of the grazing trial, since the other one-half were healed dehorned steers. One-half of the steers (three) in each lot were implanted with 24 mg. diethylstilbestrol per head in 1957.

All steers were wormed with 4 ounces of phenothiazine at the beginning of the test and were given a second 4-ounce dose three weeks later. Salt and steamed bone meal were fed free choice and separately to all lots.

Experimental Results

The results of the grazing phase are given for 1956, 1957, and 1958 in Tables 3, 4, and 5, respectively.

Table 3.—Grazing, February 1-March 29, 1956—58 Days

Treatment	Grazing + Hay	Grazing + Hay	Grazing + Hay	Grazing	Grazing	Grazing
Lot No.	1	2	3	4	5	6
Acres/lot	4	4	4	4	4	4
Steers/lot	6	6	6	6	6	6
Av. final wt. March 29, lbs.	539	516	551	589	519	551
Av. initial wt., Feb. 1, lbs.	400	382	396	406	388	405
Av. gain, lbs.	139	134	155	183	131	146
Av. daily gain, lbs.	2.4	2.3	2.7	3.2	2.3	2.5
Av. value March 29 @ $16.00/cwt.	$86.24	$82.56	$88.16	$94.24	$83.04	$88.16
Av. cost/steer to Feb. 1 @ $18.22/cwt.	$72.88	$69.60	$72.15	$73.97	$70.69	$73.79
Difference in cost to Feb. 1 & value March 29, the end of Phase II*	$13.36	$12.96	$16.01	$20.27	$12.35	$14.37

*Not net profit. See discussion of results, Phase II, for explanation.

Discussion of Results — Phase II

In 1956, the calves that were dehorned immediately before the beginning of Phase II gained as well the first three (28-day) weigh periods as those that were healed dehorned. In 1958, one steer in Lot 5 died from unknown causes. In two of the three years tested the steers that were fed hay in addition to the grazing, gained less than those on grazing alone.

Table 4.—Grazing, January 10, 1957—April 4, 1957—84 Days

Treatment	Grazing + Hay	Grazing + Hay	Grazing + Hay	Grazing	Grazing	Grazing
Lot No.	1	2	3	4	5	6
Acres/lot	4	4	4	4	4	4
Steers/lot	6	6	6	6	6	6
Av. final wt. April 4, lbs.	591	563	581	572	566	585
Av. initial wt. Jan. 10, lbs.	427	429	427	427	430	431
Av. gain, lbs.	164	134	154	145	136	154
Av. daily gain, lbs.	1.95	1.60	1.83	1.73	1.62	1.83
Av. value April 4 @ $18.00/cwt.	$106.38	$101.34	$104.58	$102.96	$101.88	$105.30
Av. cost to Jan. 10 @ $19.28/cwt.	$ 82.33	$ 82.71	$ 82.33	$ 82.33	$ 82.90	$ 83.10
Difference in cost to Jan. 10 & value April 4, the end of Phase II*	$ 24.05	$ 18.63	$ 22.25	$ 20.63	$ 18.98	$ 22.20

*Not net profit. See discussion of results, Phase II, for explanation.

Table 5.—Grazing, December 5, 1957—April 8, 1958—124 Days

Treatment	Grazing + Hay	Grazing + Hay	Grazing + Hay	Grazing	Grazing	Grazing
Lot No.	1	2	3	4	5	6
Acres/lot	4	4	4	4	4	4
Steers/lot	6	6	6	6	5	6
Av. final wt. April 8, lbs.	633	640	650	647	637	640
Av. initial wt. Dec. 5, lbs.	421	421	422	420	419	422
Av. total gain, lbs.	212	219	228	227	218	218
Av. daily gain, lbs.	1.71	1.77	1.84	1.83	1.76	1.76
Av. value April 8 @ $24.00/cwt.	$151.92	$153.60	$156.00	$155.28	$152.88	$153.60
Av. cost to Dec. 5 @ $23.57/cwt.	$ 99.23	$ 99.23	$ 99.47	$ 98.99	$ 98.76	$ 99.47
Difference in cost to Dec. 5 & value Apr. 8, the end of Phase II*	$ 52.69	$ 54.37	$ 56.53	$ 56.29	$ 54.12	$ 54.13

*Not net profit. See discussion of results, Phase II, for explanation.

The figures in the last line of Tables 3, 4, and 5 are not net profit They were given to show the difference between the cost of the steer at the beginning and ending of Phase II with no expenses for the tes deducted. The expenses for the steers are deducted at the end of Phas III. Had the expenses for the test been deducted at the end of Phas II, a loss would have occurred in most years in most lots. In order to ge the maximum grazing available from the ryegrass it should be graze until after it starts to mature.

PHASE III. GRAZING AND SUPPLEMENTAL FEEDING

Experimental Procedure

Phase III was designed to study the value of supplemental feeding as the ryegrass approached maturity. The lots were set up as follows

Lot 1—Grazing + hay + 8 lbs. oats per head per day
Lot 2—Grazing + hay free choice
Lot 3—Grazing + hay + 2.3 lbs. cottonseed meal per head per day
Lot 4—Grazing alone
Lot 5—Grazing + 8 lbs. oats per head per day
Lot 6—Grazing + 2.3 lbs. cottonseed meal per head per day

Experimental Results

The results of the grazing and supplementary feeding trials are shown in Tables 6, 7, and 8 for the years 1956, 1957, and 1958, respectively.

Discussion of Results — Phase III

From the grazing and feeding results given in Tables 6, 7, and 8 it will be noted that only two lots returned a profit in 1956, one of these being the lot that was "grazed only." The greatest number of days grazed for the test was 173 days in 1958: therefore, more total gain per steer was made in that year. The highest average daily gain per steer was made during the smallest number of days grazed, which was in 1956. Ryegrass seed were harvested from all plots in 1957 and increased the net profit per acre by $20.00. The highest net profit per acre was made in 1958, which was due, in part, to a $3.50 to $4.00 per hundredweight increase in the price of the steers at the beginning and ending of the test. In the years 1956 and 1957, the starting and ending prices per hundredweight were approximately the same.

In Table 7, Lot 5, a net profit per steer of $0.91 is shown. This was due in part to the animals and not the difference in treatments. The steers in Lot 5 gained less and brought less per hundredweight than the steers in the other lots.

Table 6.—Grazing and Supplemental Feeding, March 30-May 22, 1956—54 Days

Lot No.	1	2	3	4	5	6
Treatment	Hay + Oats	Hay	Hay + CSM	Grazing Only	Oats	CSM
Av. final wt. May 22, lbs.	694	638	691	732	684	706
Av. initial wt. March 30, lbs.	539	516	551	589	519	551
Av. total gain, lbs.	155	122	140	143	165	155
Av. daily gain, lbs.	2.9	2.3	2.6	2.6	3.1	2.9
Av. wt. at auction, lbs.	660	592	642	693	649	662
Av. per cent shrink	4.9	7.2	7.1	5.3	4.9	6.2
			——— Dollars ———			
Av. price received/cwt.	15.82	15.35	15.58	15.48	15.82	16.37
Av. amount received/steer	104.41	90.87	100.02	107.28	102.67	108.37
Expenses per steer*						
For selling	4.62	4.62	4.62	4.62	4.62	4.62
Veterinary supplies	1.00	1.00	1.00	1.00	1.00	1.00
432 lbs. oats	11.66	.	...	. .	11.66	...
134.2 lbs. CSM			4.03	...	...	4.03
Hay	1.14	1.26	1.17	...	. .	...
Salt and minerals	.40	.40	.70	.63	.56	.54
Av. pasture cost/steer**	19.33	19.33	19.33	19.33	19.33	19.33
Av. cost/steer at end of Phase 1	72.88	69.60	72.15	73.97	70.69	73.79
Total expenses***	111.03	96.21	103.00	99.55	107.86	103.31
Estimated net profit or oss per steer	—6.62	—5.34	—2.98	7.73	—5.19	5.06
Estimated net profit or oss per acre	—9.93	—8.01	—4.47	11.60	—7.79	7.59

*Feed costs per cwt.—oats, $2.70; cottonseed meal, $3.00; hay, $1.00; steamed bone meal, $6.00; salt, $1.00.

**Cost of pasture included 3 diskings, seed and seeding, fertilizer, lime, and cost of applying.

***No labor included for feeding.

SUMMARY

1955-56

Supplemental feeding of steers grazing ryegrass pastures was not as profitable as grass alone. The fed animals made more total gain during the 54-day feeding and grazing period when the grass began to mature; however, the largest gains for the 112-day period were made by the group of steers on grass alone. For the first three weigh periods (28 days each) the calves that were dehorned at the beginning of the test gained as well as the calves that had been previously dehorned and were healed. The feeding of hay did not control scours. The lot that re-

Table 7.—Grazing and Supplemental Feeding, April 4-May 20, 1957—46 Days

Lot No.	1	2	3	4	5	6
Treatment	Hay + Oats	Hay	Hay + CSM	Grazing Only	Oats	CSM
Av. final wt., May 20, lbs.	684	646	656	653	639	658
Av. initial wt., April 4, lbs.	591	563	581	572	566	585
Av. total gain, lbs.	93	83	75	81	73	73
Av. daily gain, lbs.	2.02	1.80	1.63	1.76	1.59	1.59
Av final wt. less 5%	650	614	623	620	607	625
			——— Dollars ———			
Estimated price/cwt.	19.08	18.33	18.67	18.83	18.25	18.42
Estimated value/steer	124.02	112.55	116.31	116.75	110.78	115.13
Expenses per steer*						
356 lbs. oats	9.61	. .	. . .	. . .	9.61	. . .
105 lbs. CSM	. . .	. . .	3.15	. . .	. . .	3.15
Hay	1.64	1.46	2.03	. . .	. . .	. . .
Salt and minerals	.53	1.00	.57	.67	1.10	.83
Worming	.26	.26	.26	.26	.26	.26
Av. pasture cost/steer**	16.00	16.00	16.00	16.00	16.00	16.00
Av. cost/steer at end of Phase I	82.33	82.71	82.33	82.33	82.90	83.10
Total expenses***	110.37	101.43	104.34	99.26	109.87	103.34
Estimated net profit/steer	13.65	11.12	11.97	17.49	.91	11.79
Estimated net profit/acre	20.48	16.68	17.96	26.24	1.37	17.69
Plus seed harvested	20.00	20.00	20.00	20.00	20.00	20.00
Total net profit/acre	40.48	36.68	37.96	46.24	21.37	37.69

*Feed costs per cwt.—oats, $2.70; cottonseed meal, $3.00; grass hay, $1.00; steame bone meal, $6.00; salt, $1.00.

**Pasture costs include two diskings, seed and fertilizer, and cost of applicatio

***Does not include labor for feeding.

ceived only hay in addition to the grazing (Lot 2) in Phase III mad the lowest total gain.

1956-57

Steers marketed off ryegrass pastures returned more net profit pe head than steers that received supplemental feeding on the same typ pasture. Daily gains on all treatments were lower than in the 1955-5 trial. More gain was obtained from the fed steers in Phase III durin the 130 days of the test than was obtained from the non-fed lot (Lot 4 that received grazing alone.

1957-58

The highest net profit, for the third year, was returned by th steers on grazing alone. The average daily gains were lower in this tria than in the 1955-56 trial; however, the total gains were higher owin

Table 8.—Grazing and Supplemental Feeding, April 8-May 27, 1958—49 Days

Lot No.	1	2	3	4	5	6
Treatment	Hay + Oats	Hay	Hay + CSM	Grazing Only	Oats	CSM
Av. final wt., May 27, lbs.	723	759	755	768	740	751
Av. initial wt., April 8, lbs.	633	640	650	647	637	640
Av. total gain, lbs.	90	119	105	121	103	111
Av. daily gain, lbs.	1.84	2.43	2.14	2.47	2.10	2.27
Av. final wt., less 5%	687	721	717	730	703	713
			——— Dollars ———			
Estimated price/cwt.	28.00	27.50	27.50	27.00	27.50	27.50
Estimated value/steer	192.36	198.28	197.18	197.10	193.33	196.08
Expenses per steer*						
392 lbs. oats	10.58	. .	. . .	. . .	10.58	. . .
113 lbs. CSM	. . .	. .	3.39	. . .	. . .	3.39
Hay	2.65	2.75	2.60	. . .	. . .	. . .
Salt and minerals	.56	.56	.56	.56	.56	.56
Worming	.31	.31	.31	.31	.31	.31
Av. pasture cost/steer**	12.95	12.95	12.95	12.95	12.95	12.95
Av. cost/steer at end of Phase I	99.23	99.23	99.47	98.99	98.76	99.47
Total expenses***	126.28	115.80	119.28	112.81	123.16	116.68
Estimated net profit/steer	66.08	82.48	77.90	84.29	70.17	79.40
Estimated net profit/acre	99.12	123.72	116.85	126.44	105.26	119.10

*Feed costs per cwt.—oats, $2.70; cottonseed meal, $3.00; grass hay, $1.00; steamed bone meal, $6.00; salt, $1.00.

**Pasture costs include two diskings, fertilizer and cost of applications. The plots were not seeded, because of a satisfactory volunteer stand.

***Does not include labor for feeding.

Table 9.—Summary of the Daily Gains for Three Years, by Treatments

Lot No.	1	2	3	4	5	6
Treatment	Grazing + Hay + Oats	Grazing + Hay	Grazing + Hay + CSM	Grazing Alone	Grazing + Oats	Grazing + CSM
			Pounds			
1955—112 days	2.63	2.29	2.63	2.91	2.64	2.69
1956—130 days	1.98	1.67	1.76	1.74	1.61	1.75
1957—173 days	1.75	1.95	1.92	2.01	1.86	1.90
Average	2.12	1.97	2.10	2.22	2.04	2.11

to the longer grazing season. The total net profit was larger, partly b cause of the high price of cattle and the difference between purcha ing and selling prices. The steers that were implanted with two 24-m implants of diethylstilbestrol per steer, approximately 100 days apar gained 15 to 20 per cent faster than the steers not implanted.

GENERAL CONCLUSIONS

Under the conditions that existed in these experiments the followin conclusions seem justified:

1. It is profitable to buy weanling calves in the fall, graze ther through the winter and spring on well-fertilized ryegrass pasture and then market.
2. The feeding of grass hay to steers grazing lush ryegrass pastur is not profitable and will not control scouring.
3. The supplemental feeding of cottonseed meal or oats on ryegra pastures, after the ryegrass begins to mature, is not profitable.
4. The supplemental feeding of beef cattle on pasture does not in prove the live grade.
5. More total gain is obtained when steers are fed while grazin however, the value of the increased total gain will not offset the co of the additional feed.
6. When priced as stocker steers at the end of a test, the additiona finish carried by the fed steers does not increase their value.
7. The use of diethylstilbestrol implants increases the daily gai of steers grazing ryegrass pastures.
8. More net profit per steer is made from well-fertilized ryegras grazed alone than by supplemental feeding of grain or cottonsee meal.

LITERATURE CITED

1. Carpenter, John C. Jr., Sherman A. Phillips, and Paul B. Brown 1956. Supplemental Feeding of Steers Grazing Ryegrass Pastures Mimeographed Report 1, Northeast Louisiana Experiment Sta tion.
2. Carpenter, John C. Jr., Sherman A. Phillips, and Paul B. Brown 1957. Supplemental Feeding of Steers Grazing Ryegrass Pastures Mimeographed Report 6, Northeast Louisiana Experiment Sta tion.
3. Carpenter, John C. Jr., Sherman A. Phillips, and Paul B. Brown 1958. Supplemental Feeding of Steers Grazing Ryegrass Pastures

Mimeographed Report 15, Northeast Louisiana Experiment Station.

4. Gill, John B. 1955. Winter Grazing for Steers, Brown Loam Experiment Station, Mississippi Farm Research, Vol. 18, No. 19:3.
5. Gill, John B., and R. E. Coats. 1956. Winter Grazing Results, Brown Loam Experiment Station. Mississippi Farm Research, Vol. 19, No. 8:2.
6. Hughes, H. D., Maurice E. Heath, and Darrel S. Matcalfe. 1953. Forages, The Science of Grassland Agriculture. Iowa State College Press, Revised Edition, pp. 336-40.
7. Morrison, E. G. 1958. Winter Grazing Steers, Annual Report of Brown Loam Station. Mississippi Farm Research, Vol. 21, No. 9:2.
8. Phillips, Sherman A., and John C. Carpenter, Jr. 1953. Northeast Louisiana Experiment Station Annual Report, p. 36.
9. Phillips, Sherman A., and John C. Carpenter, Jr. 1954. Northeast Louisiana Experiment Station Annual Report, p. 43.
10. Thompson, W. R. 1951. The Pasture Book. Eighth Ed: pp. 122-23, 253-55. Bowen Press, Decatur, Ga.

Recommended Procedure for the Preparation and Grazing of Ryegrass Pastures on the Macon Ridge (Olivier and Richland Silt Loam Soils)

1. Have the soil tested.
2. Prepare a good seedbed by disking.
3. Have good surface drainage.
4. At time of planting disk in the amount and grade of fertilizer as recommended from soil analysis. If the soil is not tested, use 300 to 400 pounds of a complete fertilizer (3-12-12) plus 200 pounds of ammonium nitrate or its equivalent per acre.
5. Seed 35 to 45 pounds of ryegrass per acre, September 1 to October 1, preferably with grain drill.
6. Cultipack after seeding.
7. Topdress with 100 pounds of ammonium nitrate or its equivalent per acre in February or March if needed.
8. Start grazing when ryegrass is 8 to 10 inches high.
9. Stock at the rate of 500 to 600 pounds of live weight per acre.
10. Practice rotational grazing.
11. Avoid overgrazing. Maintain at least 3 to 4 inches of grass at all times.
12. Summer fallow ryegrass grazing area to ensure adequate moisture for germination when seeded.

fects of
APER MILL WASTE WATER
N CATTLE, CROPS and SOIL

by Lowell L. McCormick

Bulletin No. 529 December 1959

LOUISIANA STATE UNIVERSITY
AND
AGRICULTURAL AND MECHANICAL COLLEGE
AGRICULTURAL EXPERIMENT STATION
Charles W. Upp, Director

TABLE OF CONTENTS

Pa

Introduction . . . .

Review of Literature . . . .

Experimental . . . .

- Effects of paper mill waste water on crops on Almont very fine sandy loam at Taylor Place, Springhill, 1948-52 . . . .
- Effects of paper mill waste water as drinking water for steers grazing on improved pastures at Springhill, 1948-49 . . . . .
- Effects of Red Chute Bayou water containing paper mill waste as drinking water for steers grazing on improved pasture near McDade, 1949-50 . . . .
- Effects of paper mill waste water as drinking water on cows and calves grazing on improved pastures at Springhill, 1950-54 . . . .
- Effects of paper mill waste water and fresh well water as irrigation water on corn, cowpeas, pasture grasses and clovers at Springhill, 1952-56 . . . .
- Effects of waste water and fresh well water applied as irrigation water by an overhead sprinkler system on the yield of a pasture mixture . . . .

Summary and Conclusions . . . .

Literature Cited . . . .

ACKNOWLEDGEMENTS

The writer desires to express his appreciation to Dr. M. B. Sturg
Head of the Agronomy Department, Louisiana State University, f
planning this program of research, and for his valuable assistance in co
ducting this research and in the writing of the manuscript.

The writer is most grateful to the International Paper Compan
owner of the Springhill mill, for financing this research and for tl
splendid cooperation received while the research was being conducte

The writer also acknowledges the assistance of the Veterinary Scien
Department of Louisiana State University with the cattle experimen

Effects of Paper Mill Waste Water On Cattle, Crops and Soil

LOWELL L. MCCORMICK*

INTRODUCTION

Since the movement of paper mills into the South, the value of land rowing pine timber or capable of growing pine timber has greatly inreased. Many factors are responsible but no doubt the ready market for oung trees was largely responsible. Prior to 1930, only a few mills were ocated in the South and they were so scattered that little attention was paid to the economic benefits from this industry. Today there are 63 mills manufacturing paper in the South. Eight of these are located in Louisiana. Annual consumption of pulpwood in the South has risen rom 1.5 million cords in 1930 to 20.6 million cords in 1956. Consumption n Louisiana in 1956 was more than 1.6 million cords.

As with any new industry, problems arose that had to be answered. One such problem concerning agriculture was the effects of waste water rom paper mills on livestock, crops and soil. When the mills first came o the South, land values were lower, livestock numbers were fewer and upplemental irrigation as applied today was almost unknown. In reent years land use has changed. Much land previously considered unfit or farming is now being utilized, particularly land that can be irrigated. Vith greater use being made of streams and land adjacent to streams, many farmers feel that the water in the streams should be used.

The chemical composition of paper mill waste water varies between mills, depending mostly on the efficiency of the recovery equipment used nd the type of paper produced. For example, where kraft or brown paper is being manufactured the greatest concentration of chemicals in he water is sodium and sulfates. Where bleached paper is being manuactured, chlorides are among the components.

The waste water consists primarily of unrecoverable chemicals from he various washing processes. Different methods of disposing of the waste water are used at different mills. Mills located on large streams or large bodies of water usually do not have difficulties in disposing of the water. Mills located so that they have to dispose of their waste water through mall streams often have problems.

Several mills in the South are located on small streams that flow through agricultural areas where livestock drink from the streams and the stream water is used for irrigation purposes. The Springhill mill located on Bodcau Bayou, also known in some locations as Red Chu Bayou. The stream flows through Webster and Bossier parishes for a proximately 100 miles before emptying into Red River. It flows throug both upland and Red River alluvial areas.

---

*Assistant Agronomist, Department of Agronomy.

Storage facilities at the Springhill mill, where most of these expe ments were conducted, consist of four reservoirs called impoundi basins. Approximately 20,000 gallons of waste water are discharged p minute into these basins. Storage facilities are available for storing t waste water for seven months. This storage is necessary since waste wat is discharged only when conditions are favorable. The favorable cond tions are high oxygen content in the stream, low water temperatures th will slow down bacterial action, and a large volume of water in t stream to insure adequate dilution. Precautions have been followed lessen chances of harm to fish life rather than to cut down on harmf effects to domestic animals. These precautions do lessen the possibiliti of having a high concentration of waste water in the stream at any tim

During and immediately after World War II the precautions no taken were not strictly followed. The concentration of waste water w much greater at times than it is now. It was during this period of laxi that much controversy arose concerning the effects of waste water the stream. When the wastes were discharged during periods of hig water, much of the land adjacent to the stream occasionally overflowe Many farmers in the overflow areas, especially those in the Red Riv alluvial area, thought that the soil, crops grown on the overflowed so and livestock drinking the water from the stream were adversely affecte Many complaints were brought against the Springhill mill. Many lar claims for damage were involved and many claims were settled by cou action.

Since no data could be found on the specific causes of damage, tes were begun to determine the effects of this waste water. In 1947 the I ternational Paper Company, owner of the Springhill mill, entered in an agreement with the Louisiana Agricultural Experiment Station Louisiana State University to begin research to determine the effects paper mill waste water on the growth of field crops growing on so that had been flooded with waste water, on cattle that were drinking t water, and on cattle that were grazing pastures that had been floode

The first experiment was conducted adjacent to the waste water i pounding basin at Springhill and was designed to determine the effect waste water on crops and soils. The experiment, located on the Tayl place, was begun in 1948 and continued through 1952. The second e periment was conducted in 1949 on land adjacent to the waste wat mpounding basin and involved the use of steers grazing improved pasures, with one group of steers drinking only fresh or well water and nother group being forced to drink undiluted paper mill waste waters umped from the impounding basin. The third experiment was conucted during the winter of 1949 and the spring of 1950 in Bossier arish on land adjacent to Red Chute Bayou. Steers were also used in the ed Chute experiment, with one group drinking only fresh or well ater and the other group drinking only water pumped from Red Chute ayou during the time waste water was in the stream. The fourth experient was conducted at Springhill from 1950 through 1954 for the purose of determining the effect of undiluted paper mill waste water on red cows and their offspring. One group of cows drank only fresh or ell water and the pasture on which they grazed was irrigated with water rom the same source. The other group was forced to drink waste water nd their pasture was irrigated with waste water.

After the first experiment on the Taylor place, where the crops had roduced equally as well on soil flooded with waste water as on soils not looded, another experiment was begun in 1952 to determine the posibility of beneficial effects from the use of paper mill waste water for upplemental irrigation on various crops and on the soil. This work was onducted for four years by the author and is being continued by a ember of the Agronomy Department of Louisiana State University.

REVIEW OF LITERATURE

Several extensive reviews of literature have been made in recent years n relation to plant growth on saline and alkali soils. References cited n the following review were taken from the reviews of literature in *Adances in Agronomy,* Volume I; *Diagnosis and Improvement of Saline and lkali Soils,* U.S.D.A. Handbook No. 60; *Irrigated Soils* and *Botanical eview,* Volume II.

Much research has been carried on concerning saline and alkali soils n this country. Most of the work was done in the arid West where climate nd soil differ from those in the South. In this review of literature, emhasis is placed on effects of source or type of water used for irrigation.

The alkali problem is as old as agriculture itself in arid regions. One f the first workers in the United States to begin serious study of saline nd alkali soils and their relation to plant growth was Hilgard (17, 18).[1] e summarized in 1900 the data that had been accumulated. At this arly date methods for determining the harmful compounds present in the soil had been developed. Methods had also been proposed for th reclamation of soils affected by excess soluble salts in the soil or irrigatio water.

---

[1] Numbers in parentheses refer to Literature Cited, page 42.

For many years all soils containing more than 0.20 per cent solub salts were called alkali soils. Harris (13) defined soil alkali as "solub salts that make the soil solution sufficiently concentrated to inju plants." Hilgard (19) divided alkali soils in two classes: "white alkal and "black alkali." He designated white alkali soils as those containi the neutral salts, principally sodium chloride and sodium sulfate. H stated that black alkali soils were those containing either sodium bicarb nate, sodium carbonate or sodium hydroxide. Concentration of mo than 0.05 per cent of these soluble alkalies could harm the growth plants. Sigmond (35) in 1938 suggested that the salted soils be classifie according to per cent salt, type of salt, effect the salt has upon soil stru ture or a combination of these factors. He classified the soils as salin salty alkali, leached alkali, degraded alkali and regraded alkali soils.

Richards (31) with the U.S. Regional Salinity Laboratory has cla sified the soils into three groups: saline, saline-alkali and nonsaline-alk li. In this classification the conductivity of the soil extract and exchang able sodium percentage are the bases for the separation of the group This classification has generally been accepted.

Factors that cause the formation of soil alkalies have also bee thoroughly studied. McGeorge, Breazeale and Bliss (25) stated that alka soils are usually present in areas where the rate of evaporation excee rainfall. The areas included generally are those that have less than inches of rainfall. There are alkali areas not limited entirely by rainfal Magistad (26) states that another factor leading to soil alkali is po drainage, which may include both surface and subsurface. If neither su face nor ground waters can drain away, the salt will be concentrated b the evaporation of water. Sigmond (34) states that sodium salts may b only slightly predominant at the beginning of salinization, but wit further concentration, calcium may be precipitated out, leaving a hig proportion of sodium salts.

Roe (32) states that allowing the soil to become water logged is ve serious with alkali soils. Drainage is the best method of removing exce water. Subsurface drainage allows excess salts to be leached out of th soil, but some may be removed by surface drainage.

As most soils in their natural states in the rain belt of the humi South do not contain excess soluble salts, salinity will probably only b come a problem through the use of unsuitable irrigation water. In a tempting to estimate whether a source of water is suitable or not, the pub lished data may not be entirely applicable to Southern conditions. Kell

21) warns against adopting a hard and fast rule for permissible salinity n irrigation waters. He found that under laboratory conditions, leach-ng a soil with a solution having a sodium-calcium ratio of 2:1 did not in-rease the adsorbed sodium in the soil. However, he observed that this ractice might not hold true under field conditions.

Smith and others (36) classed a good irrigation water as one low in alts. They state that the combination of salts is as important as the total mount of salts. Water containing over 600 parts per million total salts of hich 50 per cent are sodium salts is of doubtful quality and could lead o soil salinity. According to McGeorge (24) the quality of irrigation ater is largely determined by the percentage of sodium and calcium in he water. The higher the calcium content of a water, that is, the harder he water, the greater its value for irrigation. Kelly, Brown and Liebig 22) also proposed that in addition to the total amount of salts in ir-igation water, quality should be determined by the ratio of cations resent. The ratio of sodium to calcium and magnesium should not ex-eed 1:1. Wilcox (42) has classified quality of irrigation water accord-ng to conductivity and per cent sodium. Waters with a conductivity of p to 2,000 micromhos per centimeter and a sodium content up to 60 er cent are considered permissible for judicious use. However, waters ot exceeding a conductivity of 750 micromhos per centimeter and a odium per cent of less than 40 are preferred. Eaton (8) found waters ontaining sodium to the extent of 65 per cent of the total cations to be f doubtful quality. Waters with less than 50 per cent sodium as total ations are satisfactory and those with over 65 per cent are a progressively reater hazard as the percentage increases. Smith and others (36) also lassified waters in respect to anions present. Waters containing 0-175 arts per million chlorides or 0-350 parts per million sulfates are classi-ied good; 175-290 parts per million chlorides or 350-600 parts per mil-ion sulfates are classified fair. All concentrations greater than these re considered poor.

Soil texture should be considered when considering quality of irri-ation water that can be used. Thorne and Peterson (38) stated that the oncentration of salt accumulating in the soil solution is usually two to ne hundred times that of the irrigation water used. In heavily irrigated andy soils the soil solution tends to approach the same concentration as he irrigation water. In clayey soils the concentration of the soil solution ear the wilting point may be 100 times that of the irrigation water here permeability is low and field capacity is high compared with the ilting percentage. Harris (13) states that because of the greater sur-ace exposed, fine clays, loams, and soils high in organic matter hold the alts by adsorption more tenaciously than the coarser grained sands.

The structure and composition of the soil may be affected by s alkalies. In the case of saline soils, Richards (31) considers the chemi changes to be merely an excess of salts. The soils generally are fl culated and their permeability is equal to or higher than that of simil nonsaline soils. Thorne and Peterson (38) agreed that saline soils a usually characterized by their excess of soluble salts although there m be some indirect effects of salts in altering soil structure, permeabil and aeration. They also state that alkali soils are usually characteriz by high exchangeable sodium, poor physical conditions and freque high alkalinity in addition to the varying amounts of soluble salts. Fort (11) stated that alkali will disperse the colloidal material in the sc resulting in the clogging of pore space and making the soil less permeab poorly aerated and undesirable for aerobic bacterial action. Harris (1 says that the chief effects of salts on physical condition of the soil a change in structure or tilth, an altering of the colloidal substances, t formation of a hard pan and change in moisture relations. Ratner (3 states that the changes in the physical properties of the soil have be noted even when there are only relatively small amounts of exchan able sodium in the soil. The properties affected were the retardation the capillary rise of water, decrease in the filterability and increase dispersibility and swelling.

The quantity of water that should be applied per irrigation h some relationship to quality of water used. McGeorge (24) found laboratory studies that more sodium was adsorbed by the soil whe small amounts of water were applied per irrigation than when enou water was applied to carry salts below the root zone. From field stud at the Safford experiment farm, McGeorge, Breazeale and Bliss (25) st that there was a rapid adsorption of sodium by the soil when water fr a well containing 4,000 parts per million total salts was used. Howev when adsorption reached a sodium percentage of 25 per cent the s was apparently in equilibrium with the salt in the irrigation water a no more sodium was adsorbed. They state that when water of hi salinity is the only water available, it is accepted practice to incre the frequency of irrigation or the volume of water used per applicati Unless water in excess of the crop requirement is applied to the lar there will be a build-up in salinity.

Several writers have established limits for various kinds of salts soil. Davis and Wilson (7) state that conditions vary so widely that fixed minimum of safe alkali content can be established. They do general minimum limits of 0.10 per cent sodium carbonate, 0.50 per ce sodium chloride or 1.00 per cent sodium sulfate. They also state th soils having less than 0.50 per cent soluble salts are safe for agricultu use and those containing over 0.50 per cent are unsafe. Fortier (11) set the minimum of safe alkali content at 0.10 per cent sodium carbonate, 0.25 per cent sodium chloride and 0.50 per cent sodium sulfate.

Sigmond (35) states that saline soils have high salt contents, at least 0.10 per cent total salts or more than 0.05 per cent sodium carbonate. Alkali soils contain at least 12 per cent exchangeable sodium and potassium in terms of exchange capacity. Thorne and Peterson (38) state that approximately 0.20 per cent soluble salts is the upper tolerant limit for crops in general.

The greatest problem with alkali in soil is its effect on plant growth and yield. It will be necessary to discuss salinity and alkalinity in soils separately as each will affect plant growth in different ways. Thorne and Peterson (38) list three ways in which the effects of salts in saline soils may depress plant growth. These are prevention of water uptake by plants, chemical effects of the salt in disturbing nutrition and metabolism of plants, and the indirect effects on soils by deterioration of permeability or aeration. Earlier investigators were continuously searching for toxic substances that were causing ill effects on plant growth. Eaton (9) was one of the first American writers to point out that when grown in saline solution, plants are merely reduced in growth without any marked change in general appearances. He stressed the fact that there is no clear-cut limit below which plants will make healthy normal growth or above which plants will be killed.

Thorne and Peterson (38) state that the relative toxicity of one salt alone or a combination of salts has been almost proportional to the concentration in the soil solution. The ease with which plants absorb soil water is a function of the difference between the osmotic pressure of the plant root cells and the sum of the osmotic pressure of the soil solution and the physical tensions on it due to the curved air-water menisci bounding the solution in the pores. Any drastic fluctuation in osmotic pressure in the soil solution would greatly influence water availability. Magistad and Reitemeier (27) showed that if the soil solution held at 15 atmospheres suction has an osmotic pressure of less than two atmospheres, that is, if it contains less than 0.4 per cent of dissolved salts, no crops suffer from salt trouble, but if the osmotic pressure at this suction is 10 atmospheres, most crops suffer severely. If the soil solution does not contain appreciable amounts of sodium carbonate or borate, the composition of the salts is relatively unimportant compared with their effect upon the osmotic pressure of the solution. According to Richards *et al.* (31) if a soil is saturated with water and then some of the solution is removed by suction and it has less than 3,000 parts per million of salts, or has a specific conductivity at 25° Centigrade of less than four millimhos per centimeter, no crop is likely to suffer from g eral salt injury. However, if the salt content exceeds 6,000 parts million or the conductivity exceeds eight millimhos per centimeter, th only salt tolerant crops will grow and even their yields are likely to reduced.

Wadleigh and Ayers (40) also indicate that the osmotic pressure the soil solution is closely related to the rate of water uptake and grov of plants in saline soils. Ayers and Campbell (1) found that with addition of increasing amounts of soluble salts to a soil, a total moist stress of 15 atmospheres will occur even at increasing soil moisture p centages. This means that the amount of moisture available betw field capacity and a total soil-moisture stress of 15 atmospheres will crease with increasing soil salinity. As electrical conductivity is easily termined, this value can be used for estimating the osmotic pressure soil solution.

Scientists do not fully agree on the effects of salt accumulation disturbing nutrition of the plant. Uhrits (39) noted that the germi tion of alfalfa seeds was retarded more by sodium chloride solutions th by mannitol solutions at equal osmotic pressures. In many instances differences between the effects of various salts and of drouth due to la of rainfall cannot be measured. The lack of water may cause resu similar to the chemical effects from salts.

Thorne and Peterson (38) state that disturbed plant metaboli caused by saline conditions has been viewed primarily in terms of trogen and carbohydrate relation. Nightingale and Farnham (29) a Hayward and Long (14) grew plants at increasing osmotic concent tion attained by concentrating the nutrient solution. The ratio of i was kept fairly uniform, but at the higher osmotic pressures the nitrog supply was extraordinarily high. Analysis showed high carbohydrate c tent despite the presence of ample nitrate.

Thorne and Peterson (38) state that the specific effects of alkali plants are distinct from those of saline soils and appear due to a h caustic alkalinity, toxicity of the carbonate ion and the effects of changeable sodium. The effects of high alkalinity seem due first to fact that some plant roots and organic matter are dissolved when the exceeds 9. High alkalinity may have important effects on plant nutriti This high alkalinity is due to the replacement of chlorides and sulfa by carbonates. The influence of exchangeable sodium is two-fold, in t it promotes poor physical condition in the soil and it brings about unbalanced nutrition in plants.

Magistad (26) and others have found that as the percentage of so um saturation became greater than 12 per cent the soils became m difficult to manage, even under comparatively low moisture contents. Bower and Turk (3) found instances of very low available supplies of calcium and magnesium in alkali soils. They state that calcium starvation is one of the injurious effects of alkali soils on plants. Breazeale (4) stated that the presence of calcium, even in minute amounts, increases the tolerance of wheat seedlings for alkalies. Mulwani (28), using lysimeters in soil solution studies, noted that the addition of sodium chloride to soil resulted in depression of solubility of phosphates. He also noted a movement of organic nitrogen constituents, iron, aluminum and manganese in soil containing low amounts of calcium. The above conditions were much less noticeable with high calcium content. As the sodium chloride was moved from the soil, the phosphate became more soluble.

Ayers, Wadleigh and Magistad (2) in 1943 grew red kidney beans using water at four concentrations of salts—0, 1,000, 2,000 and 4,000 parts per million of sodium chloride—and at three moisture tensions. The growth and yield of beans decreased as the concentration was increased or as the moisture tension increased at time of irrigation. They found that the relative effect of sodium chloride was greater when per cent moisture was lowest and moisture tension was greatest. Even though salts are usually less harmful when large amounts of calcium are present in the soil, Wadleigh, Gaugh and Kolish (41), using Pachappa loam, a soil high in calcium, found that chlorides at a high level in the soil were very toxic to the plant. Orchard grass was completely killed at 0.27 and 0.41 per cent chlorides. Calcium nitrate at the 0.40 per cent level was also lethal.

The effects of and conditions contributing to the formation of "salted" or "alkali" soils discussed in previous literature were in areas of low rainfall. Salts are not lost by leaching and only small amounts are removed by plants. In the humid South with rainfall ranging from 40 to more than 60 inches annually, "salted" soils are very seldom found under natural conditions. Very little literature is available on the effects of salts under these conditions. The quality of irrigation water for rice generally is good if it contains less than 600 p.p.m. (parts per million), of soluble salts (12). Water that contains more than that amount of sodium chloride should not be used to irrigate dry soils and cannot be used throughout the growing season and year after year without injury to both crop and soil.

For many years in Louisiana rice growers (*loc. cit.*) have found that if the soil is already moist from fresh water, rice will tolerate the following concentrations of salts as a sodium chloride in irrigation water at different stages of growth:

35 grains per gal. or 600 p.p.m.—tolerable at all stages of growth. N harmful.
70 grains per gal. or 1,200 p.p.m.—rarely harmful and only to seedlin when soil is dry enough to crack. T erable from tillering on to headir
100 grains per gal. or 1,700 p.p.m.—harmful before tillering. Tolerat from booting to heading.
200 grains per gal. or 3,400 p.p.m.—harmful before booting. Tolerat from booting to heading.

According to Sturgis (37), it is difficult to generalize on the relatic ship between the amount of salt in irrigation water and the resulta accumulation of salt in the soil. It is commonly accepted that crops w allow the accumulation of at least 0.12 per cent salts in the soil bas on the dry weight of the surface soil. The Louisiana Experiment Stati gives the following illustration to bring out the relationship betwe the concentration of salt in water and the accumulation of salt in t soil: One flooding of 6 acre inches of water containing 600 parts p million of salt would leave in the surface soil 800 pounds per acre salt. Three floodings with water of this concentration would conta about all the salt, 2,400 pounds per acre, that a rice crop could saf endure.

In years of less than normal rainfall, brackish water intrudes frc the Gulf of Mexico into the streams and waterways that supply irri tion water for the Gulf Coastal Prairie soils of Louisiana and Texas. some areas, wells are often drilled into water-bearing strata that tou nearby salt domes. They may become salty in periods of heavy dra down. When the concentration of the water reaches 1,200 p.p.m. of so um chloride, two or more floodings seriously damage the crop and in few years may produce harmful conditions in the soil. Sometimes t electrical conductivity values of saturation extracts of affected so have risen above 4.0 millimhos per centimeter at 25° C., the pH abo 7.5, the contents of soluble salts above 1,000 p.p.m., or the sodium sat rations to nearly 15 per cent.

The effects of the continued use of salt water include increases compactness or bulk density of the soil and loss of permeability of t soil to air and water.

Rice is more tolerant of water containing a mixture of soluble sa that contain relatively little sodium and chlorides. When the dissolv salts in the irrigation water are lower in concentration than the solu salts in the soil, rice has been grown during the time that the saline a saline-alkali soils are being reclaimed. If the damage to soil from t use of salt water is not of long standing, it can be corrected by flushing and increasing the surface drainage.

MacIntire and others (23) brought from Colorado to Tennessee samples of two soils from barren alkali spots. The two soils were the Grand Junction sandy loam and the Rocky Ford clay. Using lysimeters, they checked these two soils, along with a native Tennessee soil (Cumberland clay loam) to determine loss of soluble salts for four years. Neither the Cumberland clay loam nor the Rocky Ford clay lost any appreciable amounts of soluble constitutents during the four years. However, under an average rainfall of approximately 47 inches per year the Grand Junction sandy loam lost by leaching 12,500 pounds of calcium, 16,000 pounds of magnesium, 10,000 pounds of sodium, 600 pounds of potassium, 7,000 pounds of sulfates, and 26,000 pounds of chlorides per acre for the 4-year period. Over 90 per cent of these amounts were lost the first year.

Fieger and Sturgis (10) in a study of Coastal Prairie soils of Louisiana found that irrigation of the soil had increased total exchange capacity and alkalinity, probably due to the hydrolytic action of water itself or of water in combination with monovalent basic ions. The use of saline irrigating water had caused the greatest increase in the amount of replaceable sodium in the exchange complex, whereas deep well water caused the smallest increase. The soluble alkali content was low for each irrigated soil studied, and in the case of the non-flooded soils no free alkali was present.

In March 1932, a storm along the eastern shore of Virginia flooded several thousand acres of farm land with salt water from Chesapeake Bay. Hester (16) of the Virginia Truck Experiment Station analyzed soil from fields that were inundated for different lengths of time in the flooded area. These analyses were begun immediately after the flood and were continued for several months to determine the rate at which the salts were removed, the effects of salts on various soil types, and other factors. Soils that had been plowed immediately before the flooding accumulated five times as much salt as soil that had not been broken. Coarse-textured soils that contained 0.15 per cent sodium chloride after flooding in April 1932 contained only 0.06 per cent in December 1932 after being leached by 24 inches of rainfall. In the top 3.5 inches of soil the calcium content dropped by over 50 per cent after the flooding while magnesium and sodium increased. Sandy soils low in organic matter and containing 0.2 per cent salt delayed germination of seed of several vegetables, and some young plants showed sign of injury. Field results showed injury to strawberry plants on a soil high in organic matter and with about 0.45 per cent soluble salt, mainly sodium chloride, whereas on a soil with a low organic matter content and with 0.23 per cent salt tl plants were killed outright.

Plants differ in their ability to withstand the harmful effects salinity. Briggs and Shantz (5) showed that plants have different abiliti to extract water from soils in the wilting range and the plants that a natural inhabitants of saline soils tend to have greater ability to extra water from the soils at the drier end of this range. Russell (33) stat that in practice salt tolerance is a very complex concept. The toleran of a plant may be low when it is young but high when established. A falfa is an example. Some plants, such as alkali grasses, may remain ali under conditions of high salt content in the soil, but they are not economic importance. Plants such as cereals will grow and produce mu green matter in soils too saline for them to produce any grain. Son forage crops may contain so much salts that they are unpalatable or i jurious to livestock.

In 1936 Kearney and Scofield (20) reported the choice of crops f saline soils, using as a basis the percentage of soluble salts in the tot dry weight of the soil to the depth reached by the roots. Some of tl crops that grew under the conditions of various concentrations of sa were as follows: over 1 per cent soluble salts—none; 0.8 to 1.0 per ce soluble salts—Bermuda grass; 0.6 to 0.8 per cent soluble salts—rye gra fescue, sorgo; 0.4 to 0.6 per cent soluble salts—cotton, small grains f hay; and 0.1 to 0.4 per cent soluble salts—small cereal grains, corn, pe and clovers. Less than 0.1 per cent soluble salts is negligible and usual does not harm crop production.

In recent studies at the U. S. Salinity Laboratory, Riverside, Californ (31), the tolerance of various crop plants has been studied according (1) the ability of the crop to survive in saline soils, (2) the yield of tl crop on saline soils and (3) the relative yield of the crop on a sali soil as compared with its yield on a nonsaline soil under similar gro ing conditions. In these investigations the yields of most fruit, vegetab forage and field crops were measured under specific conductances of tl saturated soil extract. The yields vary with climatic conditions but serve as a guide in determining the relative tolerance of various cro According to these studies the relative tolerance of some crop plar grown in this area may be grouped in three classes. The sensitive cro are those that are reduced in yield from salt concentrations in soils sho ing conductivity of saturation extracts as low as 2 to 4 millinhos/c Field beans, Ladino clover, red clover and white clover are included this class. The semitolerant crops are those whose yield may be reduc on soils with saturation extracts as low as 4 to 12 millimhos/cm. Includ in this class are Canary grass, brome grass, cereal grains, small grains f hay, sweet clover, Dallis grass, rye grass, alfalfa, sorghums and Sudan grass. The tolerant crops are those whose yields are not greatly reduced until conductivity of the saturation extracts of the soils exceeds 12 millimhos/cm. These include cotton, rescue grass, Bermuda grass and barley for hay and grain.

Crawford (6) began a study in Franklin, Virginia, in 1957 to determine whether certain wastes from sulfate pulp mills could be used as a source of water for spray irrigation of crops. He reports increased yields from the use of paper mill waste as a source of irrigation water for corn and peanuts. Soil tests of the irrigated area, which was classed as Norfolk sand, showed that the pH had been increased from a range of 5.6-6.9 to a range of 5.9-7.2, or about 0.3 pH. The pH of the waste water was 6.9. Studies are being conducted by other paper companies but no publications on those studies are available at this time.

EXPERIMENTAL

The Effects of Paper Mill Waste Water on Crops on Almont Very Fine Sandy Loam at Taylor Place, Springhill, 1948-52

The first experiment to determine the effects of paper mill waste water was begun in 1948. The purpose of this experiment was to determine the effects of applying paper mill waste water at different rates to the soil before planting the crops. The site selected for the experiment was on Almont very fine sandy loam soil on the Taylor farm near Springhill in Webster Parish, Louisiana. This area had been for several years in permanent pasture of common Bermuda grass and lespedeza.

The experimental design was a randomized block type with four rates of waste water applied to each of the different crops. Each treatment of water to each different crop was replicated three times. The individual plots of 14 feet by 75 feet were arranged in blocks 75 feet by 168 feet.

The treatments were no water, 3 inches of waste water, 6 inches of waste water and 12 inches of waste water applied each year. The three crops were cotton, corn, and a Dallis grass-white clover-lespedeza meadow. Common Bermuda grass which was present due to previous land use was the dominant grass in the meadow plots during the later years of the experiment.

Land preparation was begun early in March 1948. After the area had been flat broken, two tons of dolomitic limestone per acre were broadcast on the plots that were to be planted to the meadow mixture. The rows in the cotton and corn plots were then formed and undiluted waste water was pumped from the impounding basin into the furrows. The entire amount for each treatment was allowed to soak in the soil before the crops were planted. Each year the application of waste water on th plots was begun as early in the spring as possible. In years of larg amounts of rainfall in the spring, application of the predetermine amount of waste water could not be completed until approximately th middle of May. In 1950 and 1951, the crop yields were very low becaus of the late planting followed by a dry summer.

Each year after the waste water had been applied and the soil w dry enough to be plowed, a complete fertilizer was applied in the wat furrow and the rows were set up over the fertilizer just before plantin On the meadow plots, the fertilizer was broadcast as a top-dressin Cotton was fertilized with 600 pounds of 8-8-8 per acre. Corn was fe tilized with 400 pounds of 8-8-8 per acre plus 400 pounds of sodium n trate applied as a side-dressing when the corn reached a height of a proximately one foot. Three hundred pounds of 3-12-12 per acre we disked into the soil before the Dallis grass and lespedeza were planted i May. In the fall of 1948, white clover was seeded on the meadow plot and each spring thereafter 400 pounds of 8-8-8 per acre were applie The variety of cotton planted each year was DPL 15, and the corn hybri was Dixie 11.

After the waste water had been applied each spring, and the cro were planted, all plots in each crop were cultivated in a like manne The cotton and corn plots were four rows wide, but only the two insi rows were harvested for yield determinations. The yields from the me dow plots were determined by cutting the entire plot and weighing th dry forage from two 10 feet by 10 feet squares from each replicatio Yield data for each of the different crops with the different rates of wat are presented in Table 1 for the years 1948 through 1952. Yields fro the meadow plots were obtained from 1948 through 1951.

The data show no significant differences in yield for any crop f any particular water treatment for the years tested. The yields of cro varied considerably from year to year. Some years the cotton and co could not be planted until late May or early June. The yields were rel tively low during the entire test period. The cotton suffered in 1950 a 1951 from insufficient moisture, and additional losses were caused fro heavy boll weevil infestation. However, no detrimental effects on th crop yield could be ascribed to waste water.

At the conclusion of the experiment in 1952 soil samples were take from each replication of each treatment to determine differences in p cent organic matter, pH and soluble salts that may have accumulated a result of the effects from waste water. The results of these analyses a presented in Table 2.

The data from Table 2 show that the change in pH and retention soluble salts in the soil was negligible after five years for all rates of paper mill waste water. The pH was slightly higher on plots irrigated with paper mill waste water than on the check plots, but for no treat-

TABLE 1.—Effects of annual applications of 3, 6 and 12 inches per acre of paper mill waste water containing 1,200 to 1,800 parts per million total solids on the yields of cotton, corn and clover-grass hay on Almont very fine sandy loam at Taylor Place, Springhill, Louisiana, 1948-1952

	Pounds of seed cotton per acre					
Treatment	1948	1949	1950	1951	1952	Av.
No waste water added	667	1,167	435	47	1,228	709
3 in. waste water	725	1,250	451	73	1,257	751
6 in. waste water	623	1,208	427	92	1,190	708
12 in. waste water	683	1,215	449	83	1,317	749

	Pounds of shelled corn per acre					
Treatment	1948	1949	1950	1951	1952	Av.
No waste water added	1,064	2,979	2,324	1,233	2,978	2,116
3 in. waste water	1,344	3,500	2,559	1,250	3,127	2,356
6 in. waste water	1,019	3,192	2,699	1,017	2,727	2,131
12 in. waste water	1,198	3,517	2,559	1,051	2,703	2,205

	Pounds of grass-clover hay per acre				
Treatment	1948	1949	1950	1951	Av.
No waste water added	2,535	3,028	3,613	4,400	3,394
3 in. waste water	2,302	2,911	3,574	3,900	3,172
6 in. waste water	2,749	3,031	3,580	3,367	3,182
12 in. waste water	2,524	3,021	3,677	3,800	3,255

TABLE 2.—Effects of annual additions of 3, 6 and 12 inches per acre of paper mill waste water containing 1,200 to 1,800 parts per million total solids on organic matter, pH and per cent soluble salts in the soil on Almont very fine sandy loam planted to cotton, corn and grass-clover meadow, 1948-1952

	Cotton			Corn			Grass-clover meadow		
Treatment	% O.M.	pH	% Sol. salts	% O.M.	pH	% Sol. salts	% O.M.	pH	% Sol. salts
No waste water added	1.112	5.7	0.02	1.020	5.6	0.03	1.185	6.5	0.02
3 in. waste water	1.050	6.1	0.02	1.110	6.8	0.02	1.196	6.5	0.03
6 in. waste water	1.000	5.8	0.02	1.006	6.0	0.03	1.202	6.7	0.02
12 in. waste water	1.052	6.2	0.02	1.120	6.2	0.02	2.220	7.0	0.02

ments was the pH excessive. The biggest increases in the pH of the gras clover plots were brought about by the addition of agricultural lim stone. No detrimental conditions were developed due to flooding wit any of the three rates of paper mill waste water.

Effects of Paper Mill Waste Water as Drinking Water for Steers Grazing on Improved Pasture at Springhill, 1948-49

An experiment to determine the effects of undiluted waste water a a source of drinking water for steers grazing on improved pasture ac jacent to the impounding basin at Springhill was conducted from Augus 1948 through October 1949. The site was on Almont very fine sand loam, a soil representative of much of the soil in the Springhill are

The experiment involved two pasture areas, each containing 6. acres. Five steers were grazed in each pasture area. The steers in on pasture area were required to drink paper mill waste water pumped d rectly from the impounding basin. This water was undiluted except fo dilution caused by rainfall in the basin itself.

The areas to be used for pasture were cleared during the early par of August 1948. Part of this land had been in row crops several year back, so clearing it consisted mainly of removing underbrush and smal trees with a bulldozer. Soil tests showed a need for lime, and 1.5 ton of dolomitic limestone per acre were applied on August 15, 1948. Th areas were then double disked and leveled.

On September 20, 1948, the areas were fertilized with 3-12-12 at th rate of 400 pounds per acre and seeded to Victorgrain oats at the rate c one bushel per acre. White clover was seeded at the rate of 6 pounds pe acre on October 13, and Dallis grass was seeded at the rate of 14 pound per acre on October 18, 1948.

Plans were made to begin grazing the pastures about the first part c February 1949, but, since the soil had been broken relatively deep in pr paring the seedbed, the pastures were too boggy to support the animal Grazing had to be postponed until April 2. Two hundred pounds of 5-1 5 fertilizer per acre were applied on February 3, 1949. Kobe lespedeza a the rate of 15 pounds per acre was seeded on March 1, 1949.

Ten grade Hereford steers to be used in the experiment were pu chased February 11, 1949. Nine of the steers were purchased from th Beene Planting Company near Bossier City and one from the Clark-Kell auction. This steer also came from the Beene Planting Company herd. representative of the Louisiana State University Veterinary Science D partment ear tagged, wormed and vaccinated the steers for blackleg an malignant edema on February 15, 1949. The steers were then weighe and placed in one of the two groups of five animals each according t weight, type and general characteristics. The steers were permitted to graze when possible on the pastures until April 2, 1949, with all the animals drinking fresh well water. On April 2, the steers were weighed and grouped again as originally separated. One group was placed on its pasture area and forced to drink paper mill waste water pumped directly from the impounding basin while the other group was placed in the second pasture area and continued drinking fresh well water.

Some supplemental feed was necessary in the spring after the oats were grazed down and before the Dallis grass made sufficient growth to furnish adequate grazing. The supplemental feed was Sudan grass hay. Supplemental feed was also necessary from September 1 until October 19, the date on which the test ended. The feed consisted of one pound of cottonseed meal, three pounds of cottonseed hulls and approximately four pounds of alfalfa hay per steer per day. The final weighing was made at the pastures on October 19, 1949. Data showing weights of the two groups of steers are presented in Tables 3 and 4.

At the final weighing at the pastures the steers were inspected by anyone who so desired. Two members of the Veterinary Science Department of Louisiana State University inspected the steers before their removal to

TABLE 3.—Monthly weights showing gains or losses of steers forced to drink undiluted paper mill waste water while being grazed on improved pasture at Springhill

Steer No.	Weights of steers, lbs.							Gain to Oct. 19
	Apr. 2	May 2	June 2	July 2	Aug. 2	Sept. 7	Oct. 19	
402	545	590	600	676	717	764	695	150
403	650	719	726	732	816	845	835	185
411	560	605	660	717	767	805	790	230
414	570	620	653	722	750	799	800	230
424	635	665	706	755	794	826	785	150
Av. wt	592	640	669	720	768	808	781	189

TABLE 4.—Monthly weights showing gains or losses of steers forced to drink fresh well water while being grazed on improved pasture at Springhill

Steer No.	Weights of steers, lbs.							Gain to Oct. 19
	Apr. 2	May 2	June 2	July 2	Aug. 2	Sept. 7	Oct. 19	
401	555	595	630	676	715	768	720	165
407	555	603	669	697	763	799	780	225
408	645	717	757	817	890	909	905	260
409	555	618	636	657	733	754	725	170
413	642	715	753	793	869	908	850	208
Av. wt.	590	650	689	728	794	828	796	206

the slaughter house. They reported that the cattle receiving fresh water had slightly longer and rougher coats of hair than those drinking waste water. Immediately after the weighing at Springhill the animals were trucked to Shreveport and put in a dry lot at the Shreveport Packing Company. Early on the morning of October 20, a slaughter house number replacing the original identification number was attached to each steer so that inspecting veterinarians could not identify the animals by number. The steers were weighed and then slaughtered. As each animal was slaughtered, four local veterinarians, two staff members of the Veterinary Science Department and a representative of the State Livestock Sanitary Board examined the internal organs and carcasses.

The reports submitted by the staff members of the Veterinary Science Department were summarized as follows: There was a general infestation with internal parasites. There was a slight inflammation of the ileo-cecal orifice in 7 of the 10 animals. One in the waste water group and two in the fresh water group did not show inflammation of the ileo-cecal orifice The majority of the animals showed some slight irritation in various areas along the intestines. This is not at all uncommon. In one waste water animal there was a healed area in the mouth and another had one light colored kidney. One animal in the fresh water group had a small cyst in one lobe of the left kidney.

The observations cited were the only abnormal things seen and they were not significant. There was nothing of a gross pathological nature to differentiate the animals of the two groups. All veterinarians present agreed that all carcasses, on the basis of routine slaughter house inspection, were equally suitable for human consumption.

Two staff members of the Louisiana State University Animal Industry Department examined, on October 24, 1949, all 10 carcasses in the cooler of the Shreveport Packing Company. From the group which had drunk fresh well water, two carcasses were graded high medium, two low medium and one common. From the group which had drunk paper mill waste water, two carcasses were graded medium, two low medium and one high common.

Data in Table 3 show that the average gain per steer for the period of test, April 2 to October 19, for the steers drinking waste water was 189 pounds. Data in Table 4 show that the average gain per steer for the period of test, April 2 to October 19, for the steers drinking fresh well water was 206 pounds. The average difference of 17 pounds per steer between the steers drinking fresh well water and those drinking waste water is not statistically significant. A difference of 32 pounds is required for significance. The animals in both groups on the pasture areas lost weight before the October 19 weighing because of lack of sufficient forage in the pasture areas.

Effects of Red Chute Bayou Water Containing Paper Mill Waste as Drinking Water for Steers Grazing on Improved Pasture near McDade, 1949-50

An experiment was conducted from October 1948 through June 1950 at McDade, Louisiana, on land bordering Red Chute Bayou. This stream carries the waste water from the Springhill paper mill to the Red River. Many of the complaints relating to damages from waste water to agriculture were from farmers along Red Chute Bayou. The greatest objection to the use of this stream for the disposal of paper mill waste was associated with damage to cattle. This experiment was designed to determine whether or not the waste water in Red Chute Bayou was harmful to cattle. The topography and soil conditions at this location were very similar to those on the land in use by the cattlemen in the vicinity. Red Chute Bayou is used for watering livestock by most landowners along the stream.

The site for the experiment was carefully selected. Since the practice in this area is to graze steers on supplemental pasture crops and clover-grass mixtures, this practice was followed in the experiment. The 16-acre area was fenced and work was begun toward establishing the pastures. Seedbed preparation was begun on October 4. The entire area was fertilized with 500 pounds of 3-12-12 per acre and seeded to one bushel of Victorgrain oats per acre on October 27. On November 2, white clover and Dallis grass were seeded at the rate of 6 pounds and 15 pounds per acre, respectively. The area was then divided into four pastures of four acres each. In two of the pastures the steers were required to drink fresh well water while in the other two pastures the steers were required to drink water pumped from Red Chute Bayou.

The steers were to have been placed on the pastures in late November 1948. However, because of the late planting and the boggy nature of the recently prepared seedbed, grazing was delayed until the fall of 1949. The period that the steers were on the pasture had to coincide with the time that the waste water was being discharged through Red Chute Bayou. This period varied from year to year but usually began in late November, and waste water was usually in the stream at different concentrations until April or May.

In the spring of 1949 the oats and clover were cut for hay early enough for the clover to reseed and for the Dallis grass not to have too much competition. Through the summer of 1949, the pastures were clipped to keep the weeds down. Common rye grass was seeded in late September at a heavy rate to prevent clover bloat.

During the latter part of September 1949, 16 steers were purchased for this experiment. They were all grade Herefords obtained at livestock auctions in Northwest Louisiana and Southwest Arkansas. Th steers were divided into four groups on the basis of weight and class o November 11, 1949. On this date the steers were wormed, vaccinated fo blackleg and hemorrhagic septicemia and tatooed by a member of th staff of the Louisiana State University Veterinary Science Department The steers were permitted to graze on the entire area and all dran well water until November 28, 1949. On this date the steers were weighe again and two groups of four steers each were placed in two of th four-acre pastures and were forced to drink water containing paper mil waste pumped from Red Chute Bayou. Two groups of four steers eac were placed in two other four-acre pastures and were forced to drin fresh well water. At that time the water in the bayou was discolored b paper mill waste. The steers remained on the pastures and drank th kind of water indicated until the end of the experiment on June 14 1950, when the bayou was free from paper mill waste.

The growth of both rye grass and clover was poor in the pastur areas when grazing began, so each steer was given one pound of cottonseed meal and approximately eight pounds of alfalfa-grass hay per day There was very little green forage available in late December, so th cottonseed meal was increased to two pounds per steer per day.

The steers were weighed every 14 days in order to determine whethe they had refused to drink the bayou water for a long enough time t cause loss of weight. By early spring the white clover was growing s luxuriantly that some of the steers were beginning to bloat.

Three steers died during the experiment. Two of these were on contaminated bayou water. The first, No. 47V, died February 19, 1950, an was posted by two veterinarians from Shreveport, who attributed deat to pneumonia. The second steer, No. 45V, died during the night or earl morning of March 30, 1950. This steer was posted March 31 by a member of the staff of the Veterinary Science Department of Louisiana Stat University and four Shreveport veterinarians. All agreed that the stee died from clover bloat. The third steer, No. 49V, died during the nigh of April 2 or early morning of April 3, 1950. He was on one of th pasture areas where the steers drank fresh well water. The steer wa posted April 4 by three veterinarians from Shreveport and all agree that the steer died from clover bloat.

After it was determined that the death of two steers had bee caused by clover bloat, controlled grazing was begun, and dry hay wa fed to prevent bloat. The steers were penned late each afternoon an held overnight. Dry hay was fed each morning before turning the steer back on the pastures.

In the original design of the experiment, one of the four lots o steers was to have been grazed on a pasture irrigated with waste wate from Red Chute Bayou and one lot was to have been grazed on a pasture irrigated with fresh well water. The other two lots were to have been grazed on non-irrigated pastures in one of which waste water from the bayou was to be used for drinking water and in the other fresh well water was to be used for drinking. Since irrigation could not be provided, the experiment finally consisted of two lots of eight steers each. One lot was on a non-irrigated pasture and drank waste water from the bayou, and the other lot was on a non-irrigated pasture and drank fresh well water. As mentioned above, one steer on waste water died of pneumonia, one steer on waste water died of clover bloat and one steer on fresh water died of clover bloat before the end of the experiment. Data in Table 5 show the bi-monthly weights of each of the steers drinking waste water from the bayou. Data in Table 6 show the bi-monthly weights of each of the steers on fresh well water.

The 13 steers that remained in the experiment were trucked to Shreveport Packing Company's slaughter house on June 14, 1950. Each

TABLE 5.—Bi-monthly weights showing gains or losses of steers forced to drink Red Chute Bayou water containing paper mill waste water while being grazed on improved pasture near McDade, 1949-50

Steer	Weights per steer, lbs.							
No.	Nov. 28	Dec. 12	Dec. 27	Jan. 10	Jan. 24	Feb. 7	Feb. 25	Mar. 14
43V	565	600	620	655	630	645	660	675
53V	420	470	510	505	520	555	560	600
41V	385	425	445	440	430	465	510	550
45V	505	555	570	565	575	575	600	605
44V	380	380	410	400	390	380	405	460
47V	525	510	530	545	550	505	Died Feb. 19, 1950	
54V	495	515	540	530	535	570	605	640
51V	385	385	425	445	455	465	520	560
Av. wt.	457	480	506	511	511	520	551	584

Steer	Weights per steer, lbs.							Gain to
No.	Mar. 28	Apr. 11	Apr. 25	May 9	May 23	June 6	June 14*	June 6
43V	730	765	770	800	840	870	825	305
53V	640	680	675	700	740	785	760	365
41V	570	625	640	670	720	760	720	375
45V	645			Died March 31, 1950				
44V	505	520	535	600	590	635	595	255
47V	...	...	...	...	...	...	...	...
54V	660	675	700	750	800	805	760	310
51V	600	605	620	695	680	705	665	320
Av. wt.	621	645	657	703	728	760	721	322

*Weighed at Shreveport Packing Company's slaughter house.

steer was weighed and slaughter house numbers were assigned to each steer so that none of the veterinarians would be able to identify the steers during examination. Observations were made by two Louisiana State University veterinarians as to appearance and general condition. In their report, they stated that there was no indication whatsoever of any involvement of the nervous system. Two of the steers, No. 50V and No. 57V, were not of the same degree of finish as the others. However, in their opinion there was nothing out of the ordinary about these two steers. Both of them were recorded as having been smaller at the outset of the experiment than the others and never did develop quite the same degree of finish.

The steers were then slaughtered in a random order and the veterinarians inspected each carcass and the vital organs from each steer. Post-mortem observations did not reveal anything out of the ordinary. All carcasses were very acceptable for human consumption. After the carcasses had been cooled, they were graded by the Shreveport Packing Company's meat inspector. From the group that had drunk water

TABLE 6.—Bi-monthly weights showing gains or losses of steers forced to drink fresh well water while being grazed on improved pasture near McDade, 1949-50

Steer	Weights per steer, lbs.							
No.	Nov. 28	Dec. 12	Dec. 27	Jan. 10	Jan. 24	Feb. 7	Feb. 25	Mar. 14
57V	325	310	330	330	335	350	385	430
46V	490	520	530	535	540	555	585	630
59V	470	465	490	485	520	490	515	555
49V	545	535	565	560	560	555	575	615
50V	355	375	385	360	380	365	405	435
56V	395	400	410	440	430	445	500	555
52V	575	550	590	590	610	640	670	705
40V	550	560	565	530	530	530	580	640
Av. wt.	463	464	483	478	488	491	527	571

No.	Weights per steer, lbs.							Gain to
Steer	Mar. 28	Apr. 11	Apr. 25	May 9	May 23	June 6	June 14*	June 6
57V	465	520	540	575	615	635	590	310
46V	670	690	725	775	815	840	780	350
59V	595	650	680	715	765	770	740	300
49V	665	Died April 3, 1950		...	...	...	...	...
50V	470	500	525	540	550	575	560	220
56V	605	660	700	750	760	795	785	400
52V	740	770	800	835	845	875	830	300
40V	680	720	745	795	835	875	850	325
Av. wt.	611	644	674	712	741	766	734	315

*Weighed at Shreveport Packing Company's slaughter house.

containing paper mill waste, one carcass was graded good, four commercial and one utility. From the group that had drunk fresh well water, one carcass was graded good, four commercial and two utility.

The average dressing per cents for the two groups of steers were very close together. The steers drinking Red Chute Bayou water had an average dressing per cent of 56.2 and the steers drinking fresh well water had an average dressing per cent of 57.2.

The steers were on test from November 28, 1949, to June 14, 1950. According to B. O. D. tests, waste water was in Red Chute Bayou from November 17, 1949, until April 7, 1950. Data in Table 5 show that the net average gain per steer drinking water pumped from Red Chute Bayou from November 28, 1949, to June 6, 1950, the last time the steers were weighed at the pasture, was 322 pounds. Data in Table 6 show that the net average gain per steer drinking fresh well water for the same period of time was 315 pounds. This is a difference of 7 pounds per steer between the steers drinking bayou water and the steers drinking well water. This was not a significant difference in the gain for the total grazing period and the rate of gain between the two groups was quite uniform throughout the experiment. There were no indications that steers drinking Red Chute Bayou water containing paper mill waste refused to drink the water.

Both groups of steers weighed less on June 14 at the slaughter house than they did on June 6 at the pastures. The net average gain per steer for those that had drunk waste water from the bayou was 283 pounds at the packing house while the net average gain for those that had drunk fresh well water was 282 pounds.

Effects of Paper Mill Waste Water as Drinking Water on Cows and Calves Grazing on Improved Pasture at Springhill, 1950-54

An experiment was begun in September 1950 to determine the effects of undiluted paper mill waste water as a source of drinking water on the productive capacity of cows. Although the experiment was designed primarily to test the effect of paper mill waste water on cows, data were also obtained on the effects of waste water and well water on the weights and selling prices of calves.

A comparison was made between a group of bred cows grazed on pasture and forced to drink only paper mill waste water and a like group grazed on similar pasture and forced to drink fresh well water. A group of bred cows was purchased in September 1950 to be placed on the pastures. The cows were of mixed breeding, mostly Jersey, Hereford or Angus. They were tested for brucellosis and checked for pregnancy by a staff member of the Veterinary Science Department of Louisiana State University. On September 27, 1950, 16 cows that were known to be pregnant and tested negative for brucelloisis were selected. The cows were then vaccinated for brucellosis.

From the time the cows were bought until they were put on test all were together and drank well water. On October 18, 1950, the cows were separated into two groups. Eight cows were placed on one pasture area where the only drinking water was paper mill waste water and the other group was placed in a similar pasture area where the only drinking water was fresh well water.

The pastures used in this experiment were those that had been grazed by steers in an experiment in 1949. The pasture areas were 6.5 acres each and had received the same treatments since their establishment in 1948. The practices followed during this experiment made use of both permanent and temporary crops. Dallis grass and white clover had been established in 1948 and were still maintaining a good stand. Since common Bermuda grass tends to be the dominant grass in this area when pastures are regularly fertilized, this grass had become established in both pasture areas by 1950. Rye grass was overseeded on the pastures at the rate of 15 pounds per acre in October 1950, but very little grazing was available during the winter months. Supplemental feed, consisting of cottonseed cake or cottonseed meal and alfalfa-grass hay, was provided during the winter. The amount of feed provided depended on weather conditions and on amount of grazing available. Each pasture was fertilized with 200 pounds of 3-12-12 per acre in March 1951, with 200 pounds of 8-8-8 and 100 pounds of nitrate of soda in April, and with 200 pounds of nitrate of soda in June. The pastures were overgrazed in the summer and fall of 1951 as no cows could be removed from the pastures without affecting the experiment. The pastures were overseeded with 15 pounds of rye grass per acre and 15 pounds of crimson clover per acre on October 5, 1951. The pastures were top-dressed with about 230 pounds of 8-8-8 per acre in November 1951. Because of the overgrazed condition, crimson clover was seeded to insure a legume in the winter of 1951 and spring of 1952. Supplemental feed consisting of hay and grain was provided for the cows during the winter of 1951-52. The amount of supplemental feed provided depended upon weather conditions and amount of grazing available from the pastures.

In March 1952, 300 pounds of 3-12-12 per acre were applied to the pastures and in May the pastures were top-dressed with 300 pounds of 8-8-8 per acre. Then in July, 200 pounds of nitrate of soda were applied as a top-dressing. Rye grass was overseeded at the rate of 15 pounds per acre and 200 pounds of nitrate of soda per acre were applied in early November 1952. The supplemental feed provided for the cows during the winter of 1952 consisted of breeder range checkers and mixed grass hay.

In April 1953 the pastures were fertilized with 300 pounds of 3-12-12 per acre. They were top-dressed later in June with 200 pounds of nitrate of soda. Early in October 1953 the pastures were overseeded with 6 pounds of crimson clover and 15 pounds of rye grass per acre. In late March 1954 the pastures were top-dressed with 200 pounds of 3-12-12 per acre. In June 1954, 200 pounds of nitrate of soda per acre were applied as a top-dressing.

Irrigation from an overhead sprinkler system was provided in November 1952 for the pastures. Permanent underground lines were installed along the length of the pastures. The system was so designed that fresh well water could be applied to one pasture and paper mill waste water could be applied to the other pasture at the same time. Paper mill waste water was used as irrigation water on the pasture where the cattle were drinking paper mill waste water, and well water was used for irrigation on the pasture where the cattle were drinking well water. In both 1953 and 1954 it was necessary to begin irrigating the pastures in June. Water was applied as needed from June until November during these years. In 1953 irrigation was almost continuous from June until November. The last application was made to insure sufficient moisture for the germination of clover and rye grass seed in the event of no rainfall at the time. In 1952 and 1953 the months of September, October and November were very dry and not enough moisture was provided by rainfall for germination and rapid growth of pasture plants. The exact amount of water applied per acre each year was not measured but equal amounts of waste water and fresh well water were applied.

The cows on the pastures began to calve in late winter of 1950. One cow drinking fresh well water and one cow drinking waste water lost their calves prematurely. The cow that was drinking fresh well water lost her calf in November 1950 and the cow that was drinking paper mill waste water lost her calf in January 1951. Tests of tissues from the calves and of blood from the cows showed both cows to be carriers of brucellosis. Staff members of the Veterinary Science Department were unable to determine if brucellosis was the cause of the loss of the calves, but a check of the regenerative organs led them to believe that these cows would be sterile, so both were sold in 1951. Another cow in the group drinking fresh well water had difficulty in delivering an unusually large calf. This calf had to be taken by a veterinarian in May 1951 and was born dead. Later examination of the regenerative organs by Louisiana State University veterinarians led them to believe that this cow would also be sterile, so she was sold. The remaining 13 cows all gave birth to normal, healthy calves which remained with their mothers on the pastures until sold. Each calf drank from the same source of water as its dam.

Controlled breeding was practiced during the remainder of the experiment. The same Hereford bull was used for breeding both groups of cows. One pregnant cow was bought early in 1952 to replace the cow on the fresh water pasture that had lost her calf in May 1951. This gave a total of 14 cows, or 7 cows drinking each source of water. Each of the 14 cows produced a normal, healthy calf in the spring of 1952. The calves remained on the cows until they were sold in the late fall of 1952.

All 14 cows were bred and again produced calves in 1953. The calves born in 1953 were normal. One cow in the group drinking fresh well water died in September 1953. She was sick for several days, and her death was caused by severe kidney infection.

In 1954, the last year of the experiment, there were six cows in the group drinking fresh well water and seven cows in the group drinking waste water. The six cows in the group drinking fresh well water and six cows in the group drinking waste water gave birth to normal, healthy calves. One cow in the group drinking waste water was slow to breed in 1954. She had not delivered the calf when the experiment was discontinued but it was certain that she was pregnant. The calves remained with the cows until they were sold in November 1954. The 13 cows were sold within a few days after the calves were sold.

Of the losses of cows and calves during this experiment none could in any way be associated with the watering or feeding practices. All cows bred while on the experiment conceived and carried their calves to term. The general conditions of the cows in the two groups during the entire experiment were similar. Observations made frequently and regularly throughout the course of the experiment showed no dele-

TABLE 7.—Weights and prices of calves born of cows drinking waste water and grazing on pasture irrigated with waste water

Year	Av. age of calves when sold	Av. wt. of calves when sold	Av. selling price per cwt.	Av. price received per calf
	days	lbs.	dollars	dollars
1951	169	431	$29.00	$122.32
1952	174	421	22.90	96.69
1953	204	482	13.70	66.75
1954	220	430	14.80	64.04
Av.	187	441	20.10	87.45

terious effects on the reproductive capacities of cows drinking undiluted paper mill waste water.

The data in Table 7 show the average weights and prices, by years, of calves from the cows drinking waste water and grazed on pasture irrigated with waste water.

The data in Table 8 show the average weights and prices, by years, of calves from cows that were forced to drink fresh well water while being grazed on pasture irrigated with fresh well water.

TABLE 8.—Weights and prices of calves born of cows drinking fresh well water and grazed on pasture irrigated with fresh well water

Year	Av. age of calves when sold	Av. wt. of calves when sold	Av. selling price per cwt.	Av. price received per calf
	days	lbs.	dollars	dollars
1951	181	397	$29.30	$116.03
1952	175	394	21.60	85.76
1953	219	476	13.70	64.88
1954	222	470	14.20	66.61
Av.	199	432	19.70	83.32

The calves born of the cows during the experiment were of very good quality. The general appearances, average weights and the prices received for the calves when they were sold show that no practical differences existed between the two groups. After the calves were slaughtered, no differences were found between quality of the carcasses of the calves from the waste water treatment and the quality of the carcasses of the calves from the fresh water treatment. As with the cows, use of the waste as a source of drinking water and irrigation water for pasture caused no deleterious effects on calves.

Effects of Paper Mill Waste Water and Fresh Well Water as Irrigation Water on Corn, Cowpeas, Pasture Grasses and Clovers at Springhill, 1952-56

In 1952 plans were made to change the studies of effects of paper mill waste water on crops and soil. Yield data for the four previous years had shown no significant effects of waste water on the yields of crops grown on soil flooded with different amounts of water each spring before planting. The area under test could not be expanded for additional studies, so a new location was chosen for the experiment. The experiment in the past had been designed primarily to determine the detrimental effects of paper mill waste water. Previous observations by the Springhill mill had shown that corn and many vegetables were highly productive when irrigated with paper mill waste water during periods of deficient moisture.

The new experiment was located adjacent to the main waste water impounding basin, and the experiment was designed to determine both beneficial or detrimental effects of paper mill waste water when applied to corn, cowpeas and pasture mixtures. The residual effects of paper mill waste water on the oats and hairy vetch in rotation on plots previously irrigated and the effects of waste water on the soil were also studied.

The experimental area was divided into three blocks of equal size. Blocks 1 and 3 were on fairly uniform Almont very fine sandy loam soil, but block 2 was so irregular in topography that a large amount of soil was hauled in to level the surface. Much of the soil moved in was subsoil material not well suited for crop growth. This block was largely silt loam. It was poorly drained and had a more impervious surface soil and subsoil.

Each block was divided into three main plots and each of the main plots was planted to a different crop. In each main plot there were five water treatments or subplots. The subplot size for each water treatment was 25 feet by 125 feet. The water treatments were: no water added, 12 inches of waste water per acre, 12 inches of fresh well water per acre, 24 inches of waste water per acre, and 24 inches of fresh well water per acre per year.

The crop or crop combinations in the experiment each year were as follows: hairy vetch followed by corn, oats for hay followed by cowpeas, and a pasture mixture of Kentucky 31 fescue, Dallis grass and white clover. Only the corn, cowpeas and the pasture mixture were irrigated each year. The hairy vetch and the oats were grown when no irrigation water was needed.

The method used in irrigating the row crops in the experiment was by flowing the water down the middle of the row's furrows. The pasture plots were irrigated by flooding the entire plot. A levee had to be built around each plot when irrigating.

The water used for irrigation was paper mill waste water and fresh well water. The waste water was pumped directly from the impounding basin and the well water was taken from a water main used to supply water to the paper mill. The total solids in the waste water varied during the years, but most samples tested less than 1,500 p.p.m. total solids. The conductivity of the samples varied from 1,900 to 1,950 micromhos at 25 degrees C.

Hairy vetch was planted in October 1952, but no yield data were taken before it was plowed under since none of the plots had been previously irrigated. In the fall of 1953 and 1954, the plots were fertilized with 300 pounds of 3-12-12 per acre and seeded to 30 pounds of hairy vetch. The vetch was harvested, weighed and turned under in March. The vetch was not irrigated but the corn and cowpeas which it followed had received irrigation in 1953 and 1954. The yields of vetch in pounds per acre on the air-dry basis are given in Table 9.

An analysis of data in Table 9 shows that the residual effects on hairy vetch from two yearly applications of 12 inches per acre and 24 inches per acre of waste water applied to corn and cowpeas preceding vetch did not carry over to reduce the yields of vetch.

TABLE 9.—Residual effects of waste water and of fresh well water applied to preceding crops of corn and cowpeas on the yield of air-dry hairy vetch

Treatment	1954	1955	2-yr. av.	Increase for added water
	lbs./A.	lbs./A.	lbs./A.	lbs./A.
No water added	2,759	3,153	2,956	. . .
12 in. waste water	2,759	4,321	3,540	484
12 in. well water	2,614	3,044	2,829	−127
24 in. waste water	2,614	3,561	3,088	132
24 in. well water	3,049	3,025	3,037	81

Corn followed hairy vetch in the experiment. A complete fertilizer was applied to the plots to be planted to corn each year at the time of planting. In 1953 and 1954, 600 pounds of 8-8-8 per acre were used and Dixie 11 corn hybrid was planted in April. The corn was sidedressed with 300 pounds of nitrate of soda in May when it was approximately 12 inches high.

In 1953, irrigation began on June 8 and in 1954, irrigation began on June 6. It was necessary to irrigate some after the corn was made in order to get the predetermined amount of water on the plots.

Data showing yields of corn for the years 1953 and 1954 are presented in Table 10.

The addition of the waste water to corn was beneficial instead of detrimental. The increase in the yield of corn from irrigation with 12 inches of waste water per acre was 54.3 bushels per acre. The increase from 24 inches of waste water per acre was 64.8 bushels. While the increases from irrigation with fresh well water were higher than those with waste water, they were not significantly higher.

Oats were first planted in the experiment in the fall of 1952, but since none of the plots had been irrigated, no yield data were taken. In

TABLE 10.—Effects of two levels of waste water and two levels of fresh well water as irrigation waters on the yield of corn

Treatment	1953	1954	2-yr. av.	Increase for added water
	bu./A.	bu./A.	bu./A.	bu./A.
No. water added	32.2	16.9	24.6	. . .
12 in. waste water	80.9	76.8	78.9	54.3**
12 in. well water	89.2	77.9	83.6	59.0**
24 in. waste water	96.8	81.9	89.4	64.8**
24 in. well water	97.8	86.3	92.1	67.5**

**Significantly higher than non-irrigated at the 1 per cent level.

the fall of 1953 and in 1954, 300 pounds of 3-12-12 per acre were applied and 3 bushels of Ferguson oats per acre were planted on plots following corn. In 1953, the oats were top-dressed with 300 pounds of nitrate of soda per acre, and in 1954, the oats were top-dressed with 200 pounds of nitrate of soda per acre. The oats planted in the fall of 1953 were cut for hay in early April 1954. The oats planted in the fall of 1954 were cut for hay in early May 1955. The plots on which the oats were grown were irrigated in 1953 and 1954 with the amount and kind of water indicated in Table 11.

The data in Table 11 show that there were no residual effects on oats from two annual applications of 12 inches per acre and 24 inches per acre of either the waste water or the fresh well water applied to corn and cowpeas preceding oats.

TABLE 11.—Residual effects of waste water and fresh well water on the yield of air-dry oat hay

Treatment	1954	1955	2-yr. av.	Increase for added water
	T./A.	T./A.	T./A.	T./A.
No water added	2.47	3.48	2.93	. . . . .
12 in. waste water	2.67	3.63	3.15	0.22
12 in. well water	2.72	3.19	2.96	0.03
24 in. waste water	2.11	3.63	2.87	—0.06
24 in. well water	2.54	3.12	2.83	—0.10

In 1953 and 1954, after the oat stubble was plowed under, 300 pounds of 3-12-12 per acre were applied and Whippoorwill cowpeas were planted in May. In 1953, irrigation by the furrow method was begun June 19, and in 1954, irrigation was begun June 28. The yields of cowpea hay and dry cowpeas in the hull as affected by irrigation with waste water and with fresh well water are shown in Table 12.

TABLE 12.—Effects of two levels of waste water and fresh well water as irrigation waters on yields of cowpea hay and dry cowpeas in the hull

	1953		1954		2-yr. av.		Increase for added water	
Treatment	hay	peas	hay	peas	hay	peas	hay	peas
	T./A.	lbs./A.	T./A.	lbs./A.	T./A.	lbs./A.	T./A.	lbs./A.
No water added	6.47	2,628	3.22	1,314	4.85	1,971	. . .	. . .
12 in. waste water	5.89	2,282	3.70	1,936	4.80	2,109	—0.05	238
12 in. well water	6.22	2,628	3.70	2,420	4.96	2,524	0.11	553
24 in. waste water	6.22	2,558	3.53	2,212	4.88	2,395	0.03	414
24 in. well water	6.30	2,489	3.98	2,351	5.14	2,420	0.29	449

No significant beneficial or detrimental effects on the yields of cowpea hay or dry peas from the use of either kind of water were observed in 1953. In 1954, the addition of waste water and well water at the same two levels to peas significantly increased the yields of dry peas over those not irrigated. There were no significant differences in the yields of dry peas among the irrigation treatments. Neither kind of irrigation water increased the yield of cowpea hay significantly over the yield of peas not irrigated.

The pasture plots were established in the fall of 1952. Dolomitic limestone at the rate of 1.5 tons per acre and 500 pounds of 3-12-12 per acre were applied to the pasture plots on November 24, 1952. A mixture of 12 pounds of Kentucky 31 fescue, 12 pounds of Dallis grass and 8 pounds of white clover per acre was seeded on November 29. An additional 300 pounds of 3-12-12 per acre were applied as a top-dressing in April 1953. The pasture was cut on June 2, August 19 and October 15 in 1953. Nitrate of soda was applied at the rate of 200 pounds per acre after each of the first two cuttings. Total plant nutrients applied for the growing season were 120 pounds of nitrogen, 96 pounds of P_2O_5 and 96 pounds of K_2O per acre. Since the stand had not been adequate for high yields in 1953, the plots were reseeded on October 19, 1953, with 5 pounds of white clover and 19 pounds of Kentucky 31 fescue per acre. On March 27, 1954, the plots were top-dressed with 300 pounds of 3-12-12 per acre. The pasture was cut on May 17, July 12, August 12

TABLE 13.—Effects of two levels of waste water and fresh well water as irrigation waters on the yield of Kentucky 31 fescue, Dallis grass and white clover

Treatment	1953	1954	2-yr. av.	Increase for added water
	T./A.	T./A.	T./A.	T./A.
No water added	1.56	2.69	2.13	....
12 in. waste water	3.99	3.68	3.84	1.36*
12 in. well water	3.48	3.49	3.49	1.71*
24 in. waste water	3.66	3.30	3.48	1.65*
24 in. well water	3.96	3.60	3.78	1.35*

*Significantly higher than non-irrigated at the 5 per cent level.

and September 11 in 1954. Additional nitrogen at the rate of 200 pounds of nitrate of soda per acre was applied after each of the first three cuttings. Total nutrients applied for the 1954 growing season were 105 pounds of nitrogen, 36 pounds of P_2O_5 and 36 pounds of K_2O per acre. Irrigation by flooding the entire plots began June 16. The average yields for 1953 and 1954 are presented in Table 13. The addition of both levels of waste water and fresh well water to the pasture mixture increased the yields of hay by significant amounts. There were no significant differences in the yields of hay between pasture irrigated with waste water and pasture irrigated with fresh well water. There was no significant difference between the pasture mixture irrigated with 12 inches of water and the pasture mixture irrigated with 24 inches of water.

Since the 1953-54 results from the use of waste water on crops had indicated no particularly deleterious effects, it was obvious that more attention should be given to the beneficial effects from the use of waste water. The experiment was changed after 1954 and both the waste water and fresh well water were applied to the crops only when needed. The rotation of the crops and the seeding and fertilizer practices were the same as previously described except that Coastal Bermuda grass overseeded with crimson clover was substituted for the pasture mixture. The yields presented for each crop with water added as needed are averages of yields from the plots that had received 12- and 24-inch treatments of the waters before 1955.

Vetch planted in the fall of 1955 was harvested, weighed and turned under in April 1956. The data given in Table 14 are based on the yields of air-dry hairy vetch harvested from plots that had received a total of 40.0 inches of waste water or fresh well water per acre from 1953 through 1955. The data show that there were no significant residual effects on hairy vetch from the three annual applications of waste water or fresh water applied to corn and cowpeas preceding the vetch.

TABLE 14.—Residual effects of waste water and of fresh well water applied to preceding crops of corn and cowpeas on the yield of air-dry hairy vetch

Treatment	1956	Increase for added water
	lbs. /A.	lbs. /A.
No water added	1,869	. . .
Waste water added as needed	2,004	135
Well water added as needed	1,891	21

Corn followed the pasture mixture in 1955 and followed vetch in 1956. In 1955, irrigation began on June 21, and 9.5 inches of waste water and fresh well water were applied per acre in the respective treatments. In 1956, irrigation began on June 4, and 11.0 inches of waste water and fresh well water were applied per acre. The yields of corn in 1955 and 1956 are presented in Table 15.

TABLE 15.—Yields of corn as affected by the application of waste water and fresh well water

Treatment	1955	1956	2-yr. av.	Increase for added water
	bu./A.	bu./A.	bu./A.	bu./A.
No water added	42.8	36.3	39.6	. . . .
Waste water added as needed	73.4	84.3	78.9	39.3**
Well water added as needed	76.8	92.7	84.8	45.2**

**Significantly higher than non-irrigated at the 1 per cent level.

The addition of the waste water to corn was beneficial instead of detrimental in both 1955 and 1956. The yields of corn irrigated with waste water and with fresh well water were significantly higher than the yield of corn that received no irrigation. The increase in the yield of corn from irrigation with waste water was 39.3 bushels per acre, while the increase in the yield of corn from irrigation with fresh well water was

TABLE 16.—Residual effects of waste water and fresh well water applied to preceding crops of corn and cowpeas on yields of air-dry oat hay

Treatment	1956	Increase for added water
	T./A.	T./A.
No water added	4.28	. . .
Waste water added as needed	4.02	—0.26
Well water added as needed	4.25	—0.03

45.2 bushels per acre. While the increase from irrigation with fresh well water was higher than that from waste water, it was not significantly higher.

Oats planted in the fall of 1955 were cut for hay in May. Yields presented in Table 16 are based on the air-dry oat hay harvested from plots that had previously received a total of 41.0 inches of waste water per acre or 41.0 inches of fresh well water per acre from 1953 through 1955.

The data show that there were no residual effects on oats grown on plots which had been previously irrigated with either waste water or well water.

In 1955, the cowpeas were first irrigated on July 9, and 7.0 inches of waste water or fresh well water were applied per acre. In 1956, irrigation began on July 18, and 7.4 inches of waste water or fresh well water were applied per acre. The yields of air-dry cowpea hay and dry peas in the hull per acre as affected by irrigation with waste water and with fresh well water are shown in Table 17.

TABLE 17.—Effects of waste water and fresh well water applied as irrigation waters on the yields of cowpea hay and dry cowpeas in the hull

	1955		1956		2-yr. av.		Increase for added water	
Treatment	hay	peas	hay	peas	hay	peas	hay	peas
	T./A.	lbs./A.	T./A.	lbs./A.	T./A.	lbs./A.	T./A.	lbs./A.
No water added	2.44	2,540	2.32	1,572	2.36	2,056	. . .	. . .
Waste water added as needed	3.18	2,488	3.73	2,354	3.46	2,421	1.10*	365
Well water added as needed	3.19	2,385	3.71	2,710	3.45	2,548	1.09*	492

*Significantly higher than non-irrigated at the 5 per cent level.

In 1955 the addition of both the waste water and fresh well water gave increases in the yield of cowpea hay, but the use of the waters for irrigation water did not increase the yield of dry peas. In 1956 the use of both kinds of water gave increases in the yields of cowpea hay and dry cowpeas. The two-year averages show that the use of waste water and the use of fresh well water significantly increased the yield of cowpea hay. The use of the water did not significantly increase the yields of dry peas. There were no significant differences between the effects of the waste water and the fresh well water.

The pasture plots were rotated in 1955 and planted to Coastal Bermuda grass, which replaced the pasture mixture tested in 1953 and 1954. Fertilizer at the rate of 600 pounds of 5-10-10 per acre was broadcast and plowed under in March, and the Coastal Bermuda grass was sprigged on April 8, 1955. Ammonium nitrate was applied at the rate of 100 pounds per acre in June and after each of the first two cuttings. Total plant nutrients applied for the growing season were 135 pounds of nitrogen, 60 pounds of P_2O_5 and 60 pounds of K_2O per acre. Irrigation by flooding the entire plot was begun on June 28, and 13.0 inches each of waste water and fresh well water were applied per acre. The grass was cut on July 21, September 1 and October 24.

In October 1955, 15 pounds of crimson clover per acre were overseeded on the Coastal Bermuda grass. There was a very poor stand of crimson clover on the plots that had received irrigation during the summer and early fall. A top-dressing of 600 pounds of 3-12-12 was applied to the plots in March 1956. The crimson clover was cut for hay in May 1956. The Coastal Bermuda grass was cut on June 26, July 28, September 4 and October 18. Two hundred pounds of ammonium nitrate per acre were applied after the second and third cuttings. A total of 150 pounds of nitrogen, 72 pounds of P_2O_5 and 72 pounds of K_2O per acre was applied during the growing season. Irrigation of the Coastal Bermuda grass began on June 5, and 16.5 inches of each source of water were applied per acre. The yields of air-dry Coastal Bermuda grass and crimson clover hay harvested in 1955 and 1956 are presented in Table 18.

The additions of the waste water and the fresh water to Coastal Bermuda grass produced highly significant increases in the yield of hay in 1955 and 1956. There was no significant difference between the yield of Coastal Bermuda grass hay irrigated with waste water and Coastal Bermuda grass hay irrigated with fresh well water. There was no

TABLE 18.—Effects of waste water and fresh well water as irrigation waters on the yields of air-dry Coastal Bermuda grass and crimson clover hay

Treatment	1955*	1956*	2-yr. av.	Increase for added water
	T./A.	T./A.	T./A.	T./A.
No water added	3.69	4.78	4.24	....
Waste water added as needed	6.53	10.48	8.51	4.27**
Well water added as needed	6.90	10.45	8.68	4.44**

*Yields for 1955 include Coastal Bermuda grass only.

**Significantly higher than non-irrigated at the 1 per cent level.

apparent difference between the crimson clover grown on plots previously irrigated with waste water and that grown on plots previously irrigated with fresh well water.

Soil samples were taken in March 1956 to determine whether or not soluble salts were being accumulated in the soil and to determine whether changes in the pH of the soil had been caused by the use of waste water. The plots from which the samples were taken had been in the pasture mixture in 1953 and 1954, and in corn in 1955. The soluble salts and pH were determined by the State Soil Testing Laboratory at Louisiana State University. The data are presented in Table 19.

TABLE 19.—The soluble salt content and the pH of Almont very fine sandy loam as affected by the application of paper mill waste water and fresh well water as irrigation water, 1953-1955

	Block 1		Block 2		Block 3		Average	
Amount and kind of water	Sol. salts, p.p.m.	pH	Sol. salts, p.p.m.	pH	Sol. salts, p.p.m.	pH	Sol. salts, p.p.m.	pH
				Surface soil, 0 - 6 in.				
No water added	210	6.7	170	6.6	180	6.4	220	6.6
34 in. waste water	340	7.6	390	7.7	250	7.5	270	7.6
34 in. well water	180	7.1	240	6.9	190	6.7	200	6.9
58 in. waste water	850	7.4	520	7.9	380	7.9	580	7.7
58 in. well water	380	6.7	300	7.1	200	7.2	290	7.0
				Subsoil, 6 in. to 18 in.				
No water added	220	6.3	230	5.4	220	5.2	230	5.6
34 in. waste water	330	7.6	410	6.2	370	5.8	340	6.5
34 in. well water	250	6.8	380	5.2	230	5.6	310	5.9
58 in. waste water	470	7.7	790	6.3	750	5.3	670	6.4
58 in. well water	380	6.5	300	5.6	250	4.9	310	5.7

It is obvious from the data that there was no appreciable build-up of soluble salts in the soil where waste water had been applied as irrigation water. Crop plants will commonly tolerate 2,000 p.p.m. or 0.20 per cent soluble salts on the basis of soil weight if most of the salts are chlorides and sulfates. None of the treated soil tested approaches this amount. The soluble salt content was low under all irrigation treatments and varied from 170 to 850 p.p.m. There was an increase of 360 p.p.m. of soluble salts in the surface soil from the application of 58 inches of paper mill waste water per acre. This increase, as judged by standards cited in the extensive review of experiences of other workers, was too little to cause measurable detrimental effects on the crops grown in the experiment. There was some movement of soluble salts into the subsoil and the accumulation in the subsoil was in the same order as in the surface soil. It was low in both cases. The change in pH associated with the application of 58 inches of waste water per acre was from 6.6 in the surface soil of the plots that received no added water to 7.7 in plots that received 58 inches of waste water per acre. Since the change in pH was near the neutral point, it required a relatively small amount of free alkali to cause this increase in pH. The change of pH in the subsoil was from 5.6 to 6.4 from the use of waste water. The pH was not increased to the extent that any definite harm could be attributed to the increase.

Effects of Waste Water and Fresh Well Water Applied as Irrigation Water by an Overhead Sprinkler System on the Yield of a Pasture Mixture

After the cows were removed from the pasture areas that had been used for grazing studies at Springhill through 1954, an experiment was begun to determine the effects of waste water and fresh well water applied when needed as sprinkler irrigation on the yield of hay. The pasture consisted of Bermuda grass, Dallis grass and white clover. Fertilizer practices were the same as those used in irrigation studies when the waters were added by surface flooding. In 1955, irrigation began on June 30, and a total of 13.0 inches per acre was applied. The pasture treatments were cut four times in 1955 and in 1956. The yields of hay produced each year are presented in Table 20.

TABLE 20.—Effects of waste water and fresh well water applied by a sprinkler system on the yield of a mixture of Bermuda grass, Dallis grass and white clover cut for hay

Treatment	1955	1956	2-yr. av.	Increase for added water
	T./A.	T./A.	T./A.	T./A.
No water added	3.12	1.67	2.40	....
Waste water added as needed	5.32	4.38	4.85	2.45**
Well water added as needed	4.52	4.73	4.63	2.23**

**Significantly higher than non-irrigated at the 1 per cent level.

Irrigating with waste water and with fresh well water increased the yields of hay as compared with the yield from the non-irrigated treatment. Both kinds of irrigation water were equally beneficial in 1955 and 1956. The increase in the yield of hay from irrigating with waste water was 2.45 tons per acre.

In 1956, work was begun to determine the effects of paper mill waste water applied through a sprinkler system on corn heavily fertilized with varying rates of nitrogen. The corn was fertilized with 800 pounds of 8-8-8 per acre and with additional ammonium nitrate applied to bring the rates of nitrogen to 100, 150 and 225 pounds per acre. The corn was spaced with one plant every 12 inches in rows 3.5 feet apart. Irrigation with waste water began on July 4, and 10.4 inches were applied per acre to the corn receiving irrigation. Split plots of non-irrigated corn served as controls.

The yield of corn irrigated with waste water and fertilized with 100 pounds of N, 64 pounds of P_2O_5 and 64 pounds of K_2O was 94.1 bushels per acre. Corn irrigated with waste water and fertilized with 150-64-64 produced 95.5 bushels per acre. Where the plant food was increased to 225-64-64, the yield was 98.2 bushels per acre. The yield of corn not irrigated but fertilized with 100-64-64 was 34.5 bushels per acre. Corn not irrigated but fertilized with 150-64-64 produced 32.3 bushels per acre and that not irrigated but fertilized with 225-64-64 made 33.1 bushels per acre.

The yields of corn from all irrigated fertilizer treatments were significantly higher than the yields of corn from all non-irrigated fertilizer treatments. There were no significant differences in the yields of corn among any fertilizer treatments receiving waste water as irrigation water. Considerable crusting of the soil following irrigation was observed, but this is often the case regardless of the kind of water applied to row crops by sprinkler systems.

Another experiment was begun in 1956 to test the effects of waste water applied as irrigation water through a sprinkler system on common Bermuda, Coastal Bermuda grass and Dallis grass. The experiment included treatments in which each of the grasses was tested under conditions of no irrigation and no lime, no irrigation and dolomitic lime, irrigation with waste water and no lime, and irrigation with waste water and dolomitic lime. The stands were not satisfactory for taking yield data in 1956, but the experiment is being continued.

SUMMARY AND CONCLUSIONS

Studies have been made to determine the effects of paper mill waste water on cattle, crops and soil. Studies have also been made to determine whether waste water could be used as a source of irrigation water in the production of various crops.

Flooding the soil, prior to planting, with annual applications of 3, 6 and 12 inches of undiluted paper mill waste water per acre for five consecutive years caused no significant reductions in the yields of corn, cotton or a meadow mixture of Dallis grass, white clover and lespedeza. Soil analyses at the conclusion of the experiment showed no build-up of soluble salts in the soil and showed no marked increase in the pH of the soil from treatments with the various rates of paper mill waste water.

Near the Springhill mill, the use of fresh well water as drinking water for steers being grazed on improved pasture was somewhat, but not significantly, better than the use of paper mill waste water when measured on the basis of average production of beef per steer. Observations by veterinarians and meat inspectors on the steers at the time of slaughter showed no major differences in the health and quality between steers that had been on waste water and steers that had been on fresh well water.

The results of the experiment conducted near McDade showed that steers that were forced to drink water from Red Chute Bayou containing paper mill waste water while being grazed on improved pasture and steers that were forced to drink fresh well water while being grazed on improved pasture made practically the same gains of beef per steer. Examination of each steer by veterinarians after slaughter revealed only minor variances in the internal organs and carcasses between steers that had been forced to drink the different kinds of water.

Paper mill waste water was as good as fresh well water when used as a source of drinking water for bred cows and their calves. None of the cows or their calves forced to drink paper mill waste water were harmfully affected. Calves from both groups of cows were sold at 6-8 months of age. Calves that had been on waste water and calves that had been on fresh well water brought equal and good prices.

The use of paper mill waste water for the irrigation of corn, cowpeas and clover-grass meadows was particularly beneficial to corn and meadows. Yields of the crops irrigated with waste water were in general equal to the yields of the crops irrigated with fresh well water. Corn irrigated with fresh well water produced slightly higher yields than corn irrigated with waste water. The difference was not statistically significant. There were no residual effects on vetch and oats from the use of waste water applied as irrigation water to previous crops. Analyses of the soil after three years of irrigation with waste water showed that there was very little build-up of soluble salts in the soil and that there was an increase of about one unit in soil pH, which had no apparent detrimental effects on the growth of the crops.

A mixture of Dallis grass, common Bermuda grass and white clover irrigated with waste water applied through a sprinkler system produced a yield of 4.9 tons of hay per acre, which was an increase of 2.5 tons above the yield from a non-irrigated meadow.

Corn irrigated with waste water applied through a sprinkler system produced highly significant increases in yields as compared to corn receiving equal amounts of fertilizer but no irrigation.

LITERATURE CITED

1. Ayers, A. D., and R. B. Campbell. Freezing point of water in a soil as related to salt and moisture contents of the soil. Soil Sci. 72: 201-205. 1951.
2. Ayers, A. D., C. H. Wadleigh and O. C. Magistad. The interrelationships of salt concentration and soil moisture content upon the growth of beans. Jour. Am. Soc. Agron. 35: 796-810. 1953.
3. Bower, C. A., and L. M. Turk. Calcium and magnesium deficiencies in alkali soils. Jour. Am. Soc. Agron. 38: 723-727. 1946.
4. Breazeale, J. F. Alkali tolerance of plants considered as a phenomenon of adaptation. Ariz. Agr. Exp. Sta. Tech. Bul. 11. 1926.
5. Briggs, L. J., and H. L. Shantz. The relative wilting coefficients for different plants. Bot. Gaz. 53: 229-235. 1912.
6. Crawford, S. C. Sprinkler irrigation of certain wastes from sulfate pulp mills. Sewage and Industrial Wastes. 30: 1266-1272. 1958.
7. Davis, A. P., and H. M. Wilson. Irrigation Engineering. John Wiley and Sons, Inc. New York. 1919.
8. Eaton, F. M. Boron in soils and irrigation waters and its effect on plants. U.S. Dept. Agr. Tech. Bul. 448. 1935.
9. Eaton, F. M. Toxicity and accumulation of chloride and sulfate salts in plants. Jour. Agr. Res. 64: 357-399. 1942.
10. Fieger, E. A., and M. B. Sturgis. Profile studies of the coastal prairie soil of Louisiana: 1. Exchange and solution properties. Soil Sci. 38: 267-277. 1934.
11. Fortier, S. Use of Water in Irrigation. McGraw-Hill Book Co., Inc. New York. 1926.
12. Fraps, G. S. The effects of salt water on rice. Tex. Agr. Exp. Sta. Bul. 371. 1927.
13. Harris, F. S. Soil Alkali, its Origin, Nature and Treatment. John Wiley and Sons, Inc. New York. 1920.
14. Hayward, H. E., and E. M. Long. Anatomical and physiological responses of the tomato to varying concentrations of sodium chlo-

ride, sodium sulfate and nutrient solutions. Bot. Gaz. 102: 437-462. 1941.

15. Hayward, H. E., and O. C. Magistad. The salt problem in irrigation agriculture. U.S. Dept. Agr. Misc. Pub. 607. 1944.
16. Hester, J. B. A study of some salt water flooded soils on the eastern shore of Virginia. Soil Sci. 36: 427-434. 1933.
17. Hilgard, E. W. The rise of the alkali in the San Joaquin Valley. Cal. Agr. Exp. Sta. Bul. 83. 1888.
18. Hilgard, E. W. Nature, value and utilization of alkali lands. Cal. Agr. Exp. Sta. Bul. 128. 1900.
19. Hilgard, E. W. Soils. Macmillan Co. New York. 1906.
20. Kearney, T. H., and C. S. Scofield. The choice of crops for saline land. U.S. Dept. Agr. Circ. 404. 1936.
21. Kelly, W. P. Permissible composition and concentration of irrigation waters. Trans., Am. Soc. Civil Eng. 106: 849-855. 1941.
22. Kelly, W. P., S. M. Brown and G. F. Liebig, Jr. Chemical effects of saline irrigation water on soils. Soil Sci. 49: 95-107. 1940.
23. MacIntire, W. H., W. M. Shaw, B. Robinson and K. B. Sanders. The effects of additions of certain Colorado soils upon the outgo of bases, chlorides and sulfates from a Tennessee soil. Soil Sci. 36: 435-446. 1933.
24. McGeorge, W. T. The salinity problem—Safford experiment farm laboratory studies. Ariz. Agr. Exp. Sta. Tech. Bul. 125. 1952.
25. McGeorge, W. T., E. L. Breazeale and A. M. Bliss. The salinity problem—Safford experiment farm field experiments. Ariz. Agr. Exp. Sta. Tech. Bul. 124. 1952.
26. Magistad, O. C. Plant growth relations on saline and alkali soils. Bot. Rev. 11: 181-230. 1945.
27. Magistad, O. C., and R. F. Reitemeier. Soil solution concentrations at the wilting point and their correlation with plant growth. Soil Sci. 53: 351-360. 1943.
28. Mulwani, B. T. Soil solution studies in irrigation practices. Jour. Univ. Bombay 10. 1942. (Abstract in Chem. Ab. 36: 6723. 1942.)
29. Nightingale, G. T., and R. B. Farnham. Effects of nutrient concentration on anatomy, metabolism and bud abscission of sweet pea. Bot. Gaz. 97: 477-517. 1936.
30. Ratner, E. I. The influence of exchangeable sodium in the soil on the properties as a medium for plant growth. Soil Sci. 40: 459-471. 1935.
31. Richards, L. A. (ed.) Diagnosis and Improvement of Saline and Alkali Soils. U.S. Dept. Agr. Handb. No. 60. Washington, D.C 1954.

32. Roe, H. B. Moisture Requirements in Agriculture. McGraw-Hill. Inc., New York. 1950.

33. Russell, E. J. Soil Conditions and Plant Growth. Eighth ed. Longmans, Green and Co., London. 1950.

34. Sigmond, A. A. J. de. The classification of alkali and salty soils. Proc. First Int. Congress Soil Sci. 1: 330-334. 1927.

35. Sigmond, A. A. J. de. The Principles of Soil Science. Thomas Murby and Co., London. 1938.

36. Smith, H. V., A. B. Caster, W. H. Fuller, E. L. Breazeale and D. Draper. The chemical composition of representative Arizona waters. Ariz. Agr. Exp. Sta. Bul. 225. 1951.

37. Sturgis, M. B. Tolerance of rice to salt water. La. Agr. Exp. Sta. Mimeo. Rpt. 1946.

38. Thorne, D. W., and H. B. Peterson. Irrigated Soils. The Blakiston Co., Philadelphia, Pa. 1949.

39. Uhrits, R. Effect of osmotic pressure on water absorption and germination of alfalfa seeds. Am. Jour. Bot. 33: 278-285. 1946.

40. Wadleigh, C. H., and A. D. Ayers. Growth and biochemical composition of bean plants as conditioned by soil moisture tension and salt concentration. Plant Physiol. 20: 106-132. 1945.

41. Wadleigh, C. H., H. G. Gaugh and M. Kolisch. Mineral composition of orchard grass of Pachappa loam salinized with various salts. Soil Sci. 72: 275-282. 1951.

42. Wilcox, L. V. The quality of water for irrigation use. U.S. Dept. Agr. Tech. Bul. 962. 1948.

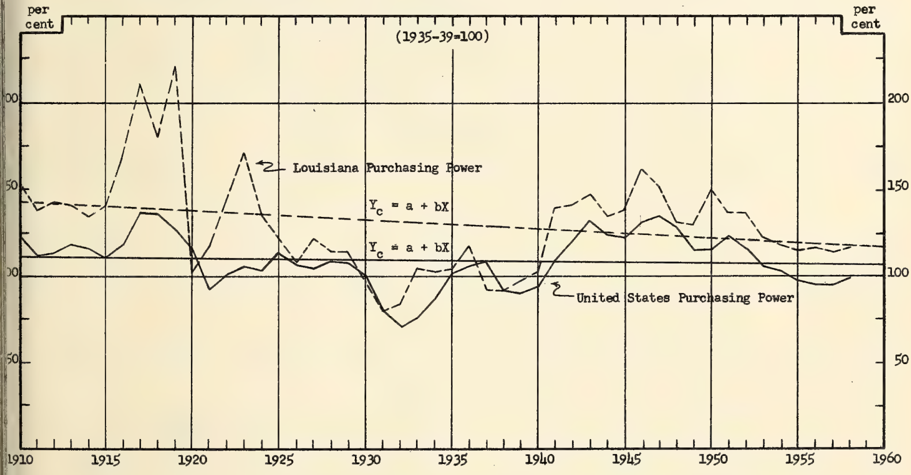
BULLETIN NO. 530 MARCH 1960

LOUISIANA FARM PRODUCTS PRICES, 1910-1959

by

J. P. MONTGOMERY

Index numbers of purchasing power per unit of farm products, Louisiana and United States, 1910-1958



LOUISIANA STATE UNIVERSITY

AND

AGRICULTURAL AND MECHANICAL COLLEGE

AGRICULTURAL EXPERIMENT STATION

CHARLES W. UPP, DIRECTOR

TABLE OF CONTENTS

Pag

Introduction 5

Figure 1. Indexes of prices received by farmers, per unit of farm products, Louisiana and United States, 1910-1958 . . . .

Table 1. Indexes of prices received per unit of farm products, of prices paid by farmers for goods and services, and of purchasing power per unit of farm products, Louisiana and United States, 1910-1959 1

Table 2. Cattle: Mid-month prices per hundred pounds received by Louisiana farmers, 1910-1959 1

Table 3. Veal calves: Mid-month prices per hundred pounds received by Louisiana farmers, 1910-1959 1

Table 4. Hogs: Mid-month prices per hundred pounds received by Louisiana farmers, 1910-1959 1

Table 5. Sheep: Mid-month prices per hundred pounds received by Louisiana farmers, 1910-1959 1

Table 6. Lambs: Mid-month prices per hundred pounds received by Louisiana farmers, 1910-1959 1

Table 7. Farm chickens: Mid-month prices per pound received by Louisiana farmers, 1910-1959 1

Table 8. Commercial broilers: Mid-month prices per pound received by Louisiana farmers, 1954-1959 1

Table 9. Turkeys: Mid-month prices per pound received by Louisiana farmers, 1930-1959 1

Table 10. Eggs: Mid-month prices per dozen received by Louisiana farmers, 1910-1959 1

Table 11. Wool: Mid-month prices per pound received by Louisiana farmers, 1910-1959 1

Table 12. Milk (wholesale): Mid-month prices per hundred pounds received by Louisiana farmers, 1910-1959 2

Table 13. Milk (retail): Mid-month prices per quart received by Louisiana farmers, 1910-1959 2

Table 14. Butter: Mid-month prices per pound received by Louisiana farmers, 1910-1952 2

Table 15. Butterfat: Mid-month prices per pound received by Louisiana farmers, 1910-1959 2

Table 16. Cotton: Mid-month prices per pound received by Louisiana farmers, 1910-1959 2

Table 17. Cottonseed: Mid-month prices per ton received by Louisiana farmers, 1910-1959 2

Table 18. Rice: Mid-month prices per hundred pounds received by Louisiana farmers, 1910-1959 2

Table 19. Cowpeas: Mid-month prices per bushel received by Louisiana Farmers, 1915-1952 2

TABLE OF CONTENTS (Continued)

able 20. Corn: Mid-month prices per bushel received by Louisiana farmers, 1910-1959 28
able 21. Oats: Mid-month prices per bushel received by Louisiana farmers, 1910-1959 29
able 22. Hay: Mid-month prices per ton received by Louisiana farmers, 1910-1959 30
able 23. Sweet potatoes: Mid-month prices per hundred pounds received by Louisiana farmers, 1910-1959 31
able 24. Irish potatoes: Mid-month prices per hundred pounds received by Louisiana farmers, 1910-1959 32
able 25. Dollars per unit of farm products received by farmers for products not marketed throughout the year, Louisiana, 1910-1959 33
able 26. All farm products: Index numbers of prices received by Louisiana farmers, by months, 1910-1959 35
able 27. Index numbers of prices received per unit of farm products by groups and index of prices paid by farmers, Louisiana, 1910-1959 36
able 28. Index numbers of purchasing power per unit of farm products, Louisiana, 1910-1959 37
able 29. Relative prices received for agricultural products by Louisiana farmers, 1910-1959 38
able 30. Meat animals: Index numbers of prices received by Louisiana farmers, by months, 1910-1959 42
able 31. Beef cattle: Relative prices received by Louisiana farmers, by months, 1910-1959 43
able 32. Veal calves: Relative prices received by Louisiana farmers, by months, 1910-1959 44
able 33. Hogs: Relative prices received by Louisiana farmers, by months, 1910-1959 45
able 34. Sheep: Relative prices received by Louisiana farmers, by months, 1910-1959 46
able 35. Lambs: Relative prices received by Louisiana farmers, by months, 1910-1959 47
able 36. Poultry and eggs: Index numbers of prices received by Louisiana farmers, by months, 1910-1959 48
able 37. Farm chickens: Relative prices received by Louisiana farmers, by months, 1910-1959 49
able 38. Commercial broilers: Relative prices received by Louisiana farmers, by months, 1954-1959 50
able 39. Turkeys: Relative prices received by Louisiana farmers, by months, 1930-1959 50
able 40. Eggs: Relative prices received by Louisiana farmers, by months, 1910-1959 51
able 41. Dairy products: Index numbers of prices received by Louisiana farmers, by months, 1910-1959 52

TABLE OF CONTENTS (Continued)

Table 42. Milk wholesale: Relative prices received by Louisiana farmers, by months, 1910-1959 . . . 53
Table 43. Milk retail: Relative prices received by Louisiana farmers, by months, 1910-1959 . . . 54
Table 44. Butter: Relative prices received by Louisiana farmers, by months, 1919-1952 . . . 55
Table 45. Butterfat: Relative prices received by Louisiana farmers, by months, 1910-1959 . . . 56
Table 46. Wool: Relative prices received by Louisiana farmers, by months, 1910-1959 . . . 57
Table 47. Cotton: Relative prices received by Louisiana farmers, by months, 1910-1959 . . . 58
Table 48. Oil bearing crops: Index numbers of prices received by Louisiana farmers, by months, 1910-1959 . . . 59
Table 49. Cottonseed: Relative prices received by Louisiana farmers, by months, 1910-1959 . . . 60
Table 50. Soybeans: Relative prices received by Louisiana farmers, by months, 1937-1959 . . . 61
Table 51. Soybeans: Mid-month prices per bushel received by Louisiana farmers, 1937-1959 . . . 61
Table 52. Rice: Relative prices received by Louisiana farmers, by months, 1910-1959 . . . 62
Table 53. Cowpeas: Relative prices received by Louisiana farmers, by months, 1915-1952 . . . 63
Table 54. Feed grains and hay: Index numbers of prices received by Louisiana farmers, by months, 1910-1959 . . . 64
Table 55. Corn: Relative prices received by Louisiana farmers, by months, 1910-1959 . . . 65
Table 56. Oats: Relative prices received by Louisiana farmers, by months, 1910-1959 . . . 66
Table 57. Hay: Relative prices received by Louisiana farmers, by months, 1910-1959 . . . 67
Table 58. Sweet potatoes: Relative prices received by Louisiana farmers, by months, 1910-1959 . . . 68
Table 59. Irish potatoes: Relative prices received by Louisiana farmers, by months, 1910-1959 . . . 69
Table 60. Peanuts: Relative prices received by Louisiana farmers, by months, 1910-1953 . . . 70
Table 61. Season price relatives received by Louisiana farmers for crops not marketed throughout the year, 1910-1959 . . . 71

Louisiana Farm Products Prices, 1910-1959[1]

J. P. MONTGOMERY

DEPARTMENT OF AGRICULTURAL ECONOMICS

The United States Department of Agriculture began the collection of rice data by crops in 1908. However, there was no widespread interest in arm product prices until the unprecedented decline in agricultural prices 1920-21 and the economic adjustments brought about by such declines. gain, price movements played a prominent part in discussions of the farm roblem throughout the very severe depression of the thirties. It was in hat period that an insistent demand for price data on a local level as well s on a national level developed. This demand has continued to grow as more and more people understand the significance of price changes.

The enactment of the Agricultural Act of 1933 aroused more general nterest in local market prices of farm products. This Act contained a clear atement of the intent of Congress to: "----- re-establish prices to farmers t a level that will give agricultural commodities a purchasing power ith respect to articles that farmers buy, equivalent to the purchasing power of agricultural commodities in the base period. The base period in he case of agricultural commodities, except tobacco, shall be the pre-war eriod, August 1909-July 1914. In the case of tobacco, the base period shall e the post war period, August 1919-July 1929." The base period for some ypes of tobacco was changed later to 1934-38. The government calculates arity prices for various commodities for the country as a whole; however, s in the case of all national averages, the United States parity prices selom reflect actual conditions in any given state.

The declared purpose of the Soil Conservation and Domestic Allotment ct of 1936 was the "-----re-establishment, at as rapid a rate as the Secetary of Agriculture determines to be practicable and in the general public nterest, of the ratio between purchasing power of the net income per peron on farms and the income per person not on farms that prevailed durng the five-year period August 1909-July 1914, inclusive, as determined rom the statistics available in the United States Department of Agriculure, and the maintenance of such ratios."

This change in emphasis did not lessen interest in prices, for prices must e used with sales data in the determination of farm income and in incomearity calculations. The interest in and demand for data on prices, parity rices and indexes of prices of farm products increased further during World War II. Farm price support programs were integral parts of the ar food programs and certain guarantees were made as to prices for two ears after the war. Support prices for agricultural products presumed to ssure specified minimum returns per unit and were implied to be the

---

Some of the prices shown for the last two years in this bulletin may be revised in ter releases by the Bureau of Agricultural Economics, U.S. Department of Agriulture, Washington, D.C.

equivalent of the contract prices for guns, ammunitions, ships, airplanes, tanks, clothing and other war materials.

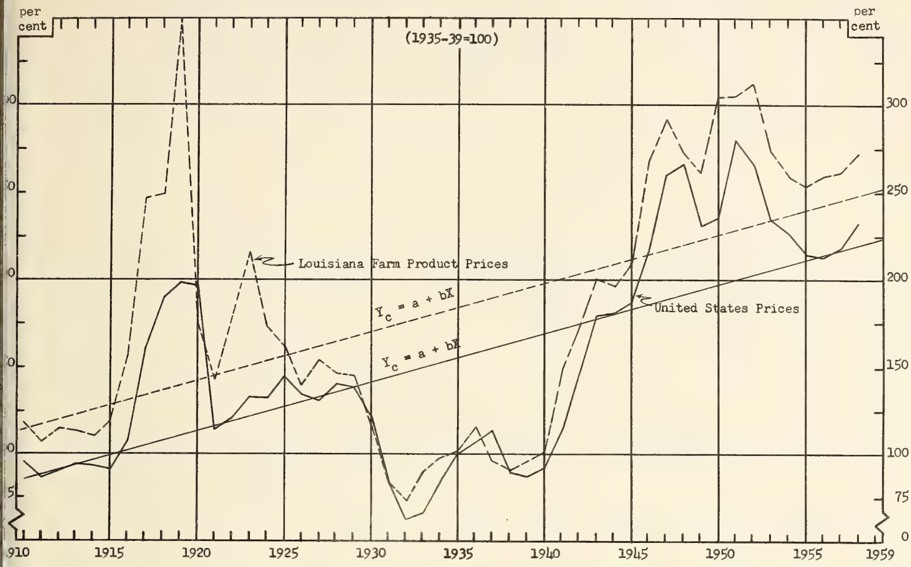
The chief legislational bases for the support price program for farm products are the Agricultural Adjustment Act of 1938, as supplemented by the Act of October 2, 1942, and the Steagall Amendment approved July 1, 1941, as amended October 2, 1942. Under the laws, it was required that prices be supported for a period extending two years after the January 1 following the date on which the President, by proclamation, or Congress, by joint resolution, declared that hostilities had ended. The President issued that proclamation on December 31, 1946. According to the law, farmers were assured price support until January 1, 1949. The laws required that the basic crops—corn, cotton, wheat, rice, tobacco, and peanuts—be supported at 90 per cent of parity (92½ per cent in the case of cotton), if marketing quotas have not been disapproved, regardless of whether or not a support was necessary to obtain the needed wartime production. Prices were required to be supported at not less than 90 per cent of parity or comparable price for any non-basic commodity that the Secretary of Agriculture found it necessary to substantially expand in production to meet the emergency. Under the legislation, lending and purchasing operations by the Federal government also were carried out in attempts to bring prices and incomes of producers of non-basic agricultural commodities not covered, to a fair parity relationship with industrial commodities.

The current parity price formula has three moving parts—an index of prices received by farmers which measures average changes from month to month, an index of prices paid by farmers, including also allowances for interest and taxes per acre of farm real estate and wage rates for hired farm labor, and, third, the relative price experience of the several farm commodities during the most recent 10-year period.

Specifically, parity prices under the modernized formula are computed by dividing the average price for each farm commodity in the latest 10-year period by the average index of prices received by farmers in the same period on a 1910-14 base. This provides an adjusted base price which is then multiplied by the current parity or prices paid index which reflects the changes in prices and cost rates paid by farmers since 1910-14. These calculations give a set of parity prices which yield for all farm products considered together the same average purchasing power as prevailed during the base period for the price indexes, that is, 1910-14, while, at the same time, the parity prices for the individual commodities are gradually adjusted so as to allow for persistence of continuing market trends.

In several cases, of course, the transition to the new or modernized parity has not been completed, so that the current or effective parity price for the commodity is influenced to some extent by the somewhat simpler method of calculation that was in effect prior to the effective date of the parity provisions of the Agricultural Act of 1948.

Figure 1.—Indexes of Prices Received by Farmers, per Unit of Farm Products, Louisiana and United States, 1910-1958



The indexes of prices received by farmers for agricultural products fluctuate more widely in Louisiana than in the United States.
Source: Table 1, Page 10.

The indexes of prices received and prices paid and comparisons they ake possible are among the most important statistics in the field of agri-ulture. These indexes would be calculated and used as a basis for compari-ons even if they were not essential components of a legally defined parity tandard.

The indexes presented in this publication were prepared primarily for ouisiana conditions. Indexes of prices of farm products for the United tates are inadequate in several respects for use in summarizing the price ituation in Louisiana. Prices behave differently in surplus producing areas nd in deficit areas. In surplus producing areas, prices tend to approximate he terminal market price minus costs of delivering the product at the erminal market. Prices received by farmers for Louisiana cotton and ice fall into this class and are affected by national and international condi-ions of supply and demand. On the other hand, deficit producing area prices end to be higher than surplus area prices by the cost of transporting the roduct from the surplus area to the deficit area. Louisiana farmers hav-ng corn for sale usually receive a higher price for corn of comparable uality than Iowa farmers because Louisiana is a deficit corn producing tate. When local production of a commodity approximates a balance with ocal demand, prices tend to be less sensitive to national and international arket changes.

Prices of different agricultural products do not rise or fall uniforml Almost every month there are some rises and some declines in price among various farm products. Even in periods of generally rapidly risin prices some individual products may decline in price. For a number o reasons, some device for measuring the general level of prices is neede and this need is met by the construction of an all-commodity, or composit index.

Objectives of Report

The purposes of this publication are: (1) to present the cash monthl and seasonal average prices received by Louisiana farmers for each o the more important farm products from 1910 through 1959; (2) to presen in tabular form monthly, seasonal, and annual price relatives for the important products; (3) to provide weighted aggregate index numbers o prices received by farmers for related groups of farm products; (4) to present indexes of monthly and weighted average annual prices received fo farm products by Louisiana farmers; and (5) to provide price data neede to make historical comparisons of current prices and price relatives wit prices for farm products since 1910.

Source of Data

The prices presented in this publication are from releases by the Louisiana Office of Agricultural Estimates, Agricultural Marketing Servic (formerly Bureau of Agricultural Economics), United States Department o Agriculture, and from releases by the Washington, D.C., Office of Agricultural Estimates. Reference is made particularly to the following releases from the Washington, D.C., Office used in determining the quantitie of various agricultural products sold by Louisiana farmers in the bas period (1935—39=100): (1) Meat Animals—Farm Production and Incom 1935-42; (2) Farm Production, Disposition, and Value of Cotton and Cottonseed and Related Data, 1928-1944; (3) Farm Production, Dispositio and Value of Rice, 1909-1941; (4) Sugarcane for Sugar and Sirup: Acreag Production and Disposition, 1909-1939; (5) Citrus Fruits: Productio Farm Disposition, Value and Utilization of Sales, October 1945; (6) Price Received by Growers for Fruit and Nut Crops, January 1945; (7) Farm Production, Disposition, and Farm Value of Corn, 1909-1941; (8) Farm Production, Disposition, and Value of Oats, 1909-1941; (9) Farm Production, Disposition and Value of Hay, 1909-1941; (10) Farm Productio Disposition, and Income from Milk, 1935-39; (11) Farm Production, Disposition and Value of Soybeans and Cowpeas, 1924-1936; (12) Farm Production, Disposition and Value of Principal Field Crops, 1937-39; (13) Farm Production, Disposition and Value of Principal Field Crops, 1938-40; (14 C. E. M. No. 1143—September 23, 1944; (15) F. A. No. 1378; and (16) C E. M. No. 511.

Method of Construction

Base Period: In constructing the indexes of prices received by Louisiana farmers for agricultural products, the weighted average seasonal prices for the 1935-39 crop years are used as a base.

Weighting: Since indexes of prices should be constructed to reflect the changes in prices received by farmers for agricultural products, the various commodities should be weighted proportionately to their economic importance in farmers' sales. Since the weighting should reflect as nearly as practical the current conditions in agriculture, the average quantities sold during the five-year period 1935-39 were used because that was the latest five-year period for which data were available at the time that the first computations were made. Agriculture is an ever changing industry. Some products have declined, others have increased in volume of production and in importance in the agricultural economy since 1910. In order to reflect the importance of various products in the agricultural economy, a weighting base using the average quantities sold in the 1949-58 years was used in computing the indexes from 1935 to date.

Price Series Used: The Louisiana Office of Agricultural Estimates, Agricultural Marketing Service, U.S.D.A., releases data each month on prices received by farmers for various farm products as of the 15th of the month. Many of these price series are available in the Louisiana Office of the Crop Reporting Service from August 1909 to date. Other products have attained importance at different times since 1910, and Agricultural Estimates included data on them in their records as they became important. These products have been added from the time that statistical data were available.

Table 1. Indexes of prices received per unit of farm products, of prices paid by farmers for goods and services, and of purchasing power per unit of farm products, Louisiana and United States, 1910-1959

(1935-39=100)

Crop year	Prices received		Prices paid United States	Purchasing power	
	La.	U.S.		La.	U.S.
	per cent				
1910	118	95	77	153	123
1911	108	87	78	138	112
1912	115	92	81	142	114
1913	113	95	81	140	117
1914	110	94	82	134	115
1915	118	92	84	140	110
1916	156	109	93	168	117
1917	246	162	118	208	137
1918	249	189	138	180	137
1919	345	199	157	220	127
1920	175	196	171	102	115
1921	143	115	124	115	93
1922	177	122	121	146	101
1923	216	133	127	170	105
1924	173	133	128	135	104
1925	162	145	131	124	111
1926	140	135	128	109	106
1927	154	132	127	121	104
1928	147	140	129	114	109
1929	146	138	128	114	108
1930	115	119	121	95	98
1931	83	83	104	80	80
1932	74	63	89	83	71
1933	90	67	87	103	77
1934	98	83	96	102	86
1935	102	101	99	103	102
1936	116	106	99	117	107
1937	96	113	105	91	108
1938	91	90	99	92	91
1939	95	88	98	97	90
1940	101	93	99	102	94
1941	146	115	105	139	110
1942	172	147	121	142	121
1943	200	178	136	147	131
1944	196	181	145	135	125
1945	208	187	151	138	124
1946	268	217	165	162	132
1947	291	260	192	152	135
1948	274	266	207	132	129
1949	261	231	200	130	116
1950	305	237	204	150	116
1951	305	280	225	136	124
1952	311	267	229	136	117
1953	273	236	221	124	107
1954	260	228	221	118	103
1955	253	215	220	115	98
1956	259	213	222	117	96
1957	262	218	228	115	96
1958	271	232	234	116	99
1959					

Table 2. Cattle: Mid-month prices per hundred pounds received by Louisiana farmers, 1910-1959.

ear	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	Weighted avg.
	---------- dollars per hundred pounds - live weight ----------												
910	3.90	3.40	3.60	3.60	4.50	4.40	4.40	4.40	4.30	4.10	3.50	4.00	4.00
911	3.90	3.90	3.40	3.90	3.60	3.50	3.40	3.30	3.80	3.50	3.60	3.80	3.65
912	3.80	3.70	3.60	4.00	4.40	3.80	4.30	4.20	4.30	4.00	4.00	3.80	4.00
913	3.60	4.10	4.30	4.10	5.00	4.80	4.80	4.60	5.00	5.00	5.30	4.40	4.60
914	4.70	4.70	5.10	5.10	5.30	5.50	5.50	6.00	5.30	6.00	5.00	5.10	5.30
915	5.10	5.20	4.90	5.30	5.00	5.20	5.70	4.80	4.60	5.20	4.70	5.20	5.10
916	5.40	5.40	5.30	5.90	5.80	5.40	5.40	5.40	5.60	5.50	5.20	5.50	5.50
917	5.40	5.90	6.00	6.10	6.80	7.60	7.60	6.90	6.70	8.50	7.60	7.90	6.90
918	7.40	6.90	7.10	7.10	7.40	8.00	8.50	8.60	7.80	8.00	7.50	6.70	7.60
919	7.20	7.80	8.00	7.50	8.50	7.60	8.50	8.60	7.90	7.90	7.30	7.60	7.85
920	7.50	8.00	8.00	8.70	7.50	7.70	9.70	8.80	7.50	7.50	6.80	6.40	7.85
921	6.30	6.50	6.20	5.80	5.80	5.60	4.80	4.90	5.00	4.40	4.80	3.90	5.35
922	4.50	4.60	4.20	4.40	4.50	4.70	4.60	4.40	4.30	3.90	4.10	3.80	4.35
923	4.20	4.40	4.10	4.00	4.10	4.10	5.00	4.80	4.70	4.60	4.20	4.50	4.40
924	4.70	4.80	4.60	4.30	4.90	4.60	4.70	4.30	4.50	4.70	5.00	4.60	4.65
925	4.70	4.20	5.30	5.50	4.80	5.50	4.70	4.20	4.50	4.60	5.00	4.50	4.70
926	4.60	4.40	4.50	4.60	4.50	5.10	4.40	4.10	4.70	5.00	5.00	4.80	4.70
927	4.50	5.00	5.10	5.30	5.00	5.30	5.20	5.80	6.00	6.00	6.30	6.40	5.70
928	6.40	6.20	6.80	6.50	7.60	7.50	6.90	7.50	8.10	8.60	7.20	7.40	7.30
929	7.30	7.30	7.30	7.40	7.50	7.30	7.50	7.40	7.20	7.20	7.20	7.20	7.30
930	7.00	6.90	6.80	6.70	6.20	6.00	5.50	4.70	4.70	4.70	4.60	4.50	5.80
931	5.30	5.00	5.30	5.40	5.40	4.90	5.00	4.50	4.30	4.10	4.20	3.80	4.70
932	3.90	4.20	4.10	3.50	3.50	3.50	3.70	3.60	3.65	3.50	3.40	3.25	3.65
933	2.90	2.90	2.95	3.20	3.70	3.35	3.35	3.35	3.00	3.10	3.15	2.95	3.15
934	3.00	3.20	3.20	3.20	3.25	3.65	3.35	3.25	3.85	3.40	3.55	3.55	3.45
935	3.55	3.75	4.30	4.35	4.80	4.45	4.35	4.20	4.35	3.90	4.05	4.30	4.20
936	4.80	4.50	4.20	4.80	4.50	4.70	4.40	4.50	4.70	4.30	4.30	4.60	4.50
937	4.45	4.80	4.60	5.30	5.10	4.90	5.20	5.30	5.40	5.20	4.90	4.70	5.00
938	4.65	4.55	4.75	5.00	4.80	4.70	4.80	4.80	4.40	4.40	4.40	4.65	4.65
939	5.00	5.00	5.30	5.40	5.50	5.20	5.00	5.00	5.40	5.30	5.30	4.95	5.20
940	5.30	5.20	5.40	5.70	5.90	5.70	5.80	5.10	5.70	5.70	5.45	5.20	5.50
941	5.60	6.00	6.10	6.70	6.90	6.90	7.30	7.10	7.40	7.20	7.00	7.10	6.80
942	7.40	7.90	8.30	8.90	8.70	8.70	8.30	8.30	8.50	8.50	8.50	8.60	8.40
943	9.50	10.10	10.80	11.50	11.30	11.40	10.60	10.20	9.80	9.70	9.00	8.80	10.20
944	9.10	9.70	10.20	10.00	9.70	9.40	8.80	8.70	8.40	8.50	8.50	8.60	9.20
945	9.50	10.00	10.30	10.40	10.60	10.60	10.70	10.80	10.90	10.00	9.50	10.50	10.30
946	10.40	10.80	11.10	11.30	11.40	11.90	13.20	12.80	11.70	12.50	13.30	13.00	12.00
947	13.00	13.20	14.40	15.20	15.10	15.00	15.00	15.00	15.00	14.00	14.00	15.50	14.50
948	17.80	17.50	18.00	19.00	18.80	19.50	19.60	19.80	18.00	18.40	17.40	18.30	18.60
949	18.80	18.10	18.60	19.30	19.10	18.50	18.00	17.50	17.00	16.50	16.00	16.00	17.70
950	17.10	17.90	18.40	18.60	26.80	20.20	20.20	20.40	20.80	20.00	21.00	21.50	19.70
951	22.10	24.70	26.00	26.80	25.60	24.00	23.50	22.80	23.00	22.60	16.00	22.00	23.60
952	23.50	23.50	24.00	24.40	24.10	22.50	21.00	20.00	18.00	15.50	13.50	16.00	20.30
953	16.00	14.70	14.00	13.50	12.60	10.20	10.40	9.80	9.70	9.20	9.00	13.70	11.00
954	10.40	10.90	11.00	11.00	11.00	10.20	9.60	9.60	9.50	9.50	8.90	9.00	10.00
955	9.60	10.50	10.40	10.80	10.40	10.70	10.10	10.30	10.10	10.20	9.60	9.90	10.20
956	10.10	10.40	10.40	10.50	10.70	10.30	10.00	10.30	10.20	9.60	9.50	9.30	10.10
957	10.30	10.30	10.70	11.40	11.50	11.40	12.00	11.90	12.20	12.10	12.10	12.90	11.50
958	14.50	15.50	17.00	16.90	17.80	16.30	17.20	17.10	17.40	17.90	18.10	18.20	16.90
959	18.30	18.50	19.10	19.30	19.50	18.90	18.80	18.30	17.90	17.10	16.60	16.00	18.19 1/

1/ Simple average of the 12 monthly prices.

Table 3. Veal calves: Mid-month prices per hundred pounds received by Louisiana farmers, 1910-1959

Year	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	Weigh avg.
	---------- dollars per hundred pounds - live weight ----------												
1910	4.60	4.00	4.00	5.00	4.80	5.50	4.90	5.40	4.70	5.00	4.60	5.10	4.8
1911	4.80	4.70	4.20	4.20	4.20	4.20	4.90	4.50	5.70	4.70	4.50	5.10	4.6
1912	5.20	4.60	5.00	4.60	4.90	4.80	5.20	4.40	5.30	5.00	4.50	4.00	4.8
1913	3.80	4.40	4.80	4.00	6.00	5.60	5.50	5.50	5.00	6.70	5.70	4.80	5.1
1914	5.50	5.60	5.90	6.30	5.80	6.00	6.30	9.20	6.00	6.20	6.20	5.10	6.2
1915	5.80	5.90	5.70	6.20	6.10	6.00	6.60	5.90	6.10	6.00	5.30	6.00	5.9
1916	6.30	6.60	5.80	7.20	6.60	6.00	6.40	6.20	7.00	6.40	7.50	7.40	6.6
1917	7.00	6.90	8.70	8.90	9.50	8.10	9.10	8.00	8.70	8.70	9.40	9.20	8.5
1918	9.00	8.00	8.20	7.90	9.50	9.90	10.30	9.00	8.40	9.60	7.70	7.70	8.7
1919	7.80	8.20	8.50	8.60	9.20	8.60	9.00	9.40	8.90	9.30	9.50	8.30	8.8
1920	8.60	10.10	9.10	10.25	10.20	8.30	9.00	8.50	8.10	8.40	6.80	7.40	8.7
1921	7.30	7.70	7.40	7.20	6.90	6.40	5.70	4.90	5.30	5.30	4.60	5.70	6.2
1922	4.80	4.80	5.20	6.00	5.90	6.70	5.70	4.90	5.30	5.10	4.90	3.80	5.2
1923	4.50	5.10	5.20	5.10	5.60	5.20	5.50	5.40	5.10	5.20	5.00	5.00	5.1
1924	5.20	5.80	5.60	5.70	6.00	5.90	5.80	4.80	5.90	5.60	5.50	5.20	5.5
1925	5.20	6.00	6.00	7.20	6.30	6.50	5.90	4.30	5.30	7.00	7.00	5.90	6.0
1926	5.50	7.00	6.00	6.50	5.90	7.00	6.00	6.70	6.60	7.30	6.30	5.60	6.5
1927	6.00	7.00	6.80	5.90	5.60	6.70	6.30	7.30	7.90	8.00	7.90	7.30	7.2
1928	8.20	8.00	9.20	9.00	9.40	9.60	9.60	9.50	10.40	10.40	9.00	9.00	9.5
1929	9.60	9.10	9.80	10.00	10.60	10.30	10.00	10.20	9.70	9.30	9.40	9.20	9.7
1930	10.00	9.90	9.60	9.30	8.90	9.10	9.30	7.90	7.80	7.90	7.10	6.50	8.2
1931	6.40	6.10	6.30	6.70	7.10	6.10	7.30	6.50	6.00	5.50	5.20	5.10	6.0
1932	4.95	5.00	5.00	4.20	4.20	4.05	4.45	4.15	4.05	4.05	4.05	3.95	4.3
1933	4.05	4.10	3.90	3.95	4.80	4.15	4.40	4.60	4.35	3.90	3.85	3.65	4.1
1934	3.95	4.10	4.10	3.60	3.65	3.65	3.95	4.15	4.45	4.25	4.55	4.85	4.1
1935	4.85	4.85	4.85	4.95	5.50	5.70	5.10	5.20	5.90	4.90	5.40	5.90	5.3
1936	5.40	5.30	5.60	5.60	5.60	5.80	5.50	5.40	5.50	5.00	4.80	5.20	5.4
1937	5.80	5.70	5.70	6.30	6.40	5.80	5.90	6.30	6.50	6.20	6.20	5.80	6.1
1938	5.60	5.80	5.70	6.30	6.20	6.00	6.00	5.80	5.80	5.30	5.80	5.60	5.9
1939	6.10	6.20	6.80	6.90	6.90	6.90	6.60	6.40	7.10	6.70	6.30	6.10	6.6
1940	6.30	6.60	6.50	6.90	7.30	7.10	7.20	6.70	6.90	6.80	6.60	6.70	6.8
1941	7.10	7.60	7.70	8.30	8.60	8.50	9.00	8.90	9.30	9.30	8.90	9.00	8.6
1942	9.50	10.00	10.20	11.00	11.10	10.80	10.70	10.70	10.40	10.60	10.60	10.80	10.6
1943	11.20	11.80	12.30	13.00	13.00	13.50	12.90	12.10	12.00	11.60	11.30	10.80	12.0
1944	11.30	11.50	11.70	12.20	11.90	11.40	11.30	10.90	10.90	10.60	11.00	11.00	11.2
1945	11.80	11.90	12.10	12.40	12.40	12.50	12.50	12.50	12.30	12.00	11.90	12.00	12.2
1946	12.50	12.90	13.30	13.30	13.50	14.00	15.50	14.60	14.60	16.60	15.90	15.90	14.8
1947	17.00	17.00	18.00	18.40	18.40	19.00	19.40	19.10	19.20	18.00	18.00	19.30	18.4
1948	22.20	21.60	22.10	23.00	23.40	23.30	24.30	25.00	22.20	21.50	21.80	22.20	22.9
1949	23.60	21.80	22.50	22.50	23.00	22.50	22.00	21.80	21.00	19.80	20.00	20.00	21.4
1950	20.90	22.30	22.30	23.00	31.90	25.40	25.30	25.90	25.90	25.00	25.30	26.30	24.5
1951	27.20	30.50	31.20	31.90	30.60	30.60	29.00	29.00	29.00	28.20	18.80	27.50	29.4
1952	29.00	29.00	28.50	28.50	28.70	27.00	25.50	24.50	21.00	18.50	17.50	19.00	23.6
1953	19.00	18.50	18.00	17.80	17.00	14.50	15.40	14.00	12.50	12.20	12.50	18.00	15.2
1954	16.20	16.40	16.70	17.00	16.60	15.50	14.50	14.60	14.50	14.50	13.10	13.70	15.2
1955	14.70	16.30	16.40	16.60	16.40	16.00	16.10	15.90	14.90	14.90	14.40	14.40	15.6
1956	14.90	15.10	15.40	15.80	16.00	15.50	15.20	14.50	14.50	14.00	13.50	14.00	14.8
1957	15.20	15.20	15.80	17.00	17.20	16.80	17.50	17.70	18.00	17.20	17.90	18.10	16.9
1958	19.40	21.00	21.50	22.40	23.20	22.70	23.30	22.90	23.60	23.80	24.10	24.70	22.8
1959	24.80	25.40	26.00	26.40	27.00	27.00	26.90	26.50	25.70	24.00	22.50	21.00	25.2

1/ Simple average of the 12 monthly prices.

Table 4. Hogs: Mid-month prices per hundred pounds received by Louisiana farmers, 1910-1959

ear	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	Weighted avg.
	---------- dollars per hundred pounds - live weight ----------												
910	6.10	6.00	7.40	8.00	7.10	6.80	6.80	6.70	6.30	7.20	6.70	6.30	6.80
911	6.20	5.90	6.00	5.70	5.40	5.30	5.20	5.40	5.80	5.90	5.30	5.70	5.65
912	5.40	5.30	5.10	5.30	5.90	5.10	5.70	5.80	6.00	5.90	6.00	5.80	5.60
913	5.90	5.60	5.80	5.40	5.90	6.00	6.00	6.50	6.10	6.50	6.40	6.40	6.05
914	6.20	6.50	6.30	6.50	6.50	6.50	6.90	6.80	7.40	6.80	6.40	6.30	6.60
915	6.10	6.00	6.10	5.80	5.90	5.90	6.50	5.90	6.00	5.90	5.80	5.50	5.95
916	6.00	5.90	5.80	6.30	6.30	6.70	6.20	6.80	7.40	7.60	7.90	7.60	6.70
917	7.40	7.60	8.40	9.70	10.20	9.80	10.80	10.90	12.80	14.20	13.40	13.70	10.75
918	12.00	12.60	13.40	13.10	13.60	13.10	12.40	13.30	14.00	13.10	14.50	14.50	13.30
919	13.50	13.00	12.50	13.30	13.90	13.40	15.00	15.20	13.90	14.00	12.80	13.40	13.65
920	13.50	12.70	12.50	12.70	12.80	13.00	13.80	13.30	13.60	11.80	11.80	10.10	12.65
921	9.70	9.10	9.30	6.80	7.50	7.30	7.70	7.20	7.90	7.50	8.10	6.80	7.90
922	6.80	6.70	7.10	6.80	7.00	6.50	6.70	6.50	7.30	7.10	7.60	7.20	6.95
923	7.20	7.30	6.80	6.80	6.50	7.00	7.20	7.30	8.00	7.60	6.30	6.80	7.05
924	6.90	7.10	6.90	6.60	7.00	7.10	7.10	7.50	7.60	7.70	8.00	8.50	7.40
925	8.20	8.50	8.90	8.70	8.90	9.20	9.00	8.80	8.00	9.00	9.30	9.70	8.80
926	9.00	9.10	9.20	9.00	8.40	8.70	10.00	9.40	8.80	10.00	10.20	9.80	9.40
927	9.70	9.90	9.10	9.00	8.40	8.20	8.10	9.10	9.10	9.30	9.30	8.60	9.20
928	7.90	7.30	7.50	7.70	7.70	7.50	8.10	8.20	9.20	8.70	8.00	7.80	7.90
929	8.00	7.50	7.80	7.80	7.70	8.10	7.90	8.50	7.90	8.40	8.10	7.90	7.40
930	7.40	7.90	8.10	8.00	7.90	8.00	7.90	7.40	7.50	7.80	7.70	7.00	7.60
931	6.80	6.70	6.40	6.50	6.50	6.00	6.50	6.80	5.80	5.40	5.20	5.00	6.10
932	4.70	4.70	4.70	4.30	4.30	3.60	4.00	4.40	4.40	4.10	3.90	3.85	4.30
933	3.25	3.30	3.40	3.35	3.70	3.85	3.85	3.80	3.70	3.90	3.90	3.55	3.60
934	3.55	3.65	3.70	3.80	3.60	3.85	3.95	3.95	5.00	4.55	4.55	4.50	4.00
935	5.00	5.00	5.50	5.30	5.20	5.70	5.70	5.80	6.80	6.10	6.70	6.60	5.80
936	6.40	6.10	6.20	6.00	6.30	6.30	6.10	6.80	6.60	6.70	6.80	6.80	6.40
937	6.70	6.40	6.40	6.20	6.40	6.90	7.00	7.40	7.10	7.10	7.10	6.50	6.70
938	5.80	5.80	5.90	5.90	5.80	6.10	6.20	6.20	6.20	6.00	6.20	5.70	5.90
939	5.50	5.40	5.60	5.30	5.30	5.30	5.30	5.00	5.50	5.50	5.20	4.70	5.30
940	4.45	4.25	4.25	4.30	4.65	4.35	4.55	4.55	4.95	4.90	4.90	4.90	4.60
941	5.40	5.50	5.40	6.10	6.60	6.90	7.80	7.90	8.40	8.30	8.10	8.10	7.00
942	8.40	8.90	9.80	10.50	10.60	10.60	11.30	11.50	11.30	11.70	11.70	11.70	10.50
943	12.00	12.40	13.10	13.00	12.90	12.70	12.40	12.40	12.50	12.20	12.00	11.00	12.20
944	10.60	10.40	10.00	10.40	10.20	9.80	9.40	9.90	10.00	10.60	10.90	11.00	10.40
945	11.70	11.70	11.70	11.90	12.50	12.30	12.50	12.60	12.60	12.80	13.00	13.20	12.30
946	13.20	13.20	13.00	13.20	13.30	13.50	16.20	17.50	15.70	22.70	20.40	19.40	15.20
947	17.60	19.10	21.60	20.30	18.90	19.30	19.30	21.10	21.70	22.60	22.10	22.70	20.70
948	23.20	19.80	20.20	19.30	19.10	19.90	21.90	23.30	18.40	21.40	21.40	20.50	21.10
949	19.60	18.20	18.20	18.00	17.10	17.90	18.30	18.40	18.00	17.20	16.20	14.90	17.50
950	14.50	14.50	14.50	14.20	19.00	16.30	19.00	19.80	20.30	18.90	18.40	17.30	16.60
951	17.60	19.10	19.30	19.00	18.80	18.50	18.90	19.70	19.00	19.50	17.20	17.60	18.70
952	17.40	16.70	16.40	16.50	17.50	17.80	17.90	19.10	17.60	17.20	16.70	15.60	17.10
953	16.70	17.30	17.90	18.20	19.80	20.60	20.80	20.00	20.50	19.50	19.50	15.60	19.10
954	20.90	21.90	22.30	23.10	23.30	22.00	21.10	19.40	18.40	18.00	18.40	17.50	20.10
955	16.50	16.60	15.40	16.10	15.70	12.90	16.50	15.40	15.30	14.80	13.00	11.50	14.90
956	11.50	12.30	11.50	12.90	12.90	14.20	13.70	14.00	14.50	14.20	13.30	13.90	13.30
957	15.00	15.00	14.90	15.50	15.80	16.30	17.10	18.20	18.00	16.80	16.30	16.30	16.20
958	16.60	17.20	18.00	18.30	18.80	18.90	19.50	19.70	18.40	18.40	18.40	17.80	18.20
959	16.50	15.50	14.80	15.30	15.70	15.00	14.10	13.70	13.50	12.70	13.10	12.10	14.33[1]

/ Simple average of the 12 monthly prices.

Table 5. Sheep: Mid-month prices per hundred pounds received by Louisiana farmers, 1910-1959

Year	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	Weight avg.
			---------- dollars per hundred pounds - live weight ----------										
1910	4.20	4.70	4.80	4.60	4.30	3.50	3.50	3.60	4.50	4.00	5.00	6.00	4.4
1911	5.00	3.30	3.00	3.50	3.50	3.50	3.50	4.90	5.20	4.80	4.20	4.30	4.0
1912	4.50	4.70	4.90	4.80	4.10	4.00	4.00	3.00	6.00	3.80	5.00	3.80	4.4
1913	3.50	4.80	3.00	3.60	3.90	4.50	4.00	4.60	4.70	3.80	4.50	4.90	4.1
1914	4.60	4.50	3.60	5.90	5.10	5.50	4.90	5.80	4.50	5.00	4.90	5.00	4.9
1915	5.00	6.00	4.60	6.30	3.30	5.80	5.60	5.70	5.00	5.00	4.50	5.00	5.1
1916	4.50	5.50	5.10	5.60	6.30	5.00	5.50	5.50	5.40	5.40	6.50	5.80	5.5
1917	5.80	6.00	6.00	5.50	7.30	6.80	7.40	7.20	6.80	7.50	8.70	7.70	6.9
1918	7.50	7.30	8.30	6.60	8.80	9.00	9.40	8.20	8.00	8.40	8.00	7.00	8.0
1919	8.40	7.00	8.00	8.60	8.80	8.60	7.70	8.10	7.50	8.00	8.80	8.20	8.1
1920	7.70	7.20	6.60	7.40	7.30	8.80	9.00	7.80	6.50	6.60	7.00	6.30	7.3
1921	6.00	6.00	5.60	5.60	5.20	5.80	4.50	4.40	4.80	3.70	4.70	4.20	5.0
1922	4.70	3.30	3.10	4.60	5.20	3.50	4.30	4.80	4.00	3.70	4.60	3.30	4.1
1923	4.00	5.00	6.00	6.40	7.00	6.50	6.00	5.50	5.00	4.30	5.00	5.30	5.5
1924	4.50	4.80	5.00	5.20	5.50	5.00	4.50	5.00	5.00	5.60	6.20	7.00	5.1
1925	7.60	8.00	7.00	6.00	5.00	6.00	7.00	6.50	5.90	6.00	6.00	7.00	6.3
1926	7.70	7.20	6.70	4.50	4.60	4.20	4.10	5.50	7.50	5.50	6.80	5.80	5.4
1927	4.60	5.00	5.20	6.00	5.60	6.00	5.00	6.00	5.90	5.50	5.60	5.30	5.7
1928	5.20	5.20	7.00	6.00	6.60	7.00	6.60	7.00	7.50	8.00	7.50	7.90	6.9
1929	7.30	7.10	7.40	7.00	6.80	6.70	6.60	6.50	6.40	6.50	6.80	6.80	6.7
1930	6.90	6.80	6.40	6.30	5.60	5.60	5.20	5.70	6.10	5.10	5.00	5.30	5.7
1931	5.40	4.90	5.20	5.30	5.50	4.70	4.10	3.70	2.60	2.40	3.00	3.00	4.3
1932	3.30	4.00	3.90	3.70	3.50	3.30	3.20	3.40	2.95	3.10	3.55	3.50	3.4
1933	2.90	2.85	2.70	2.95	2.60	2.80	2.90	3.20	3.30	2.85	3.20	3.00	3.0
1934	3.25	3.30	3.00	3.00	2.90	2.70	2.65	2.95	2.85	2.75	3.05	3.35	3.0
1935	3.90	3.90	3.90	3.10	3.15	3.15	3.15	3.00	3.20	3.70	3.70	3.80	3.3
1936	4.00	4.00	3.60	3.80	4.05	4.05	3.90	4.00	3.90	4.10	3.80	4.05	3.9
1937	4.05	4.30	4.20	4.10	4.20	3.90	4.00	4.00	4.50	4.30	3.60	4.00	4.0
1938	4.00	4.20	3.70	3.75	3.75	3.70	4.00	4.00	3.80	3.80	3.80	3.20	3.8
1939	3.50	3.50	3.75	3.75	3.75	3.75	3.75	3.65	3.80	3.90	4.00	4.00	3.7
1940	4.00	4.20	4.20	4.00	4.00	3.90	4.20	4.00	4.00	3.75	3.80	3.60	4.0
1941	4.00	4.10	4.20	4.20	4.00	4.00	4.30	4.30	4.35	4.40	4.40	4.40	4.2
1942	4.60	4.80	4.80	5.50	6.00	5.30	5.30	5.60	5.60	5.60	5.60	5.70	5.4
1943	5.80	6.00	6.00	6.70	6.20	6.50	6.50	6.20	6.00	6.00	6.00	6.50	6.2
1944	6.00	6.20	6.20	6.50	6.00	6.30	6.10	5.90	6.00	6.50	6.50	6.50	6.2
1945	6.70	7.00	7.30	7.30	6.80	6.60	6.50	5.70	5.50	5.80	5.80	5.80	6.5
1946	5.80	6.00	6.00	6.50	6.60	6.60	7.40	7.10	7.30	7.50	7.00	7.00	6.9
1947	7.00	7.00	7.00	7.00	7.00	7.00	7.00	7.00	7.00	7.30	7.30	7.70	7.1
1948	8.00	8.00	8.40	8.40	8.50	8.50	8.90	9.50	8.90	9.10	8.90	8.60	8.8
1949	8.60	8.60	9.10	9.20	9.70	9.50	9.50	8.90	8.40	8.40	8.40	8.30	9.0
1950	9.00	9.80	9.80	10.30	13.00	10.20	10.00	10.00	10.50	10.50	11.00	12.00	10.3
1951	12.00	12.00	13.00	13.00	13.00	13.00	12.50	12.50	12.50	12.50	8.80	12.50	12.6
1952	12.50	12.50	12.50	11.70	12.00	9.80	9.80	9.80	9.80	8.80	8.80	8.80	10.6
1953	8.80	9.00	8.90	9.00	9.00	7.80	7.80	7.80	7.80	7.60	7.80	8.80	8.3
1954	8.50	8.50	8.50	8.60	8.60	8.40	8.00	7.10	7.20	6.80	7.20	6.90	8.0
1955	7.30	7.30	7.30	7.70	7.20	7.00	6.50	6.50	6.00	6.00	6.20	6.00	6.8
1956	6.00	6.00	6.50	7.20	7.00	6.50	6.00	5.80	6.00	6.10	6.10	6.40	6.3
1957	7.00	7.00	7.00	7.00	6.80	7.00	7.00	7.50	7.00	7.20	7.50	7.50	7.1
1958	7.50	7.20	7.20	7.20	7.20	7.10	7.10	7.10	7.10	7.10	7.10	7.10	7.1
1959	7.10	7.10	7.10	7.10	7.10	7.00	7.00	7.00	7.00	7.00	7.20	7.00	7.0

1/ Simple average of the 12 monthly prices.

Table 6. Lambs: Mid-month prices per hundred pounds received by Louisiana farmers, 1910-1959

ear	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	Weighted avg.
	---------- dollars per hundred pounds - live weight ----------												
10	4.40	5.00	5.10	4.90	4.70	4.30	4.00	4.30	5.40	5.50	6.00	7.00	5.05
11	5.30	3.50	3.50	4.40	5.50	4.60	4.80	5.10	5.70	5.00	4.70	4.50	4.70
12	5.10	5.30	5.40	5.10	5.50	4.90	4.70	4.00	6.50	4.00	5.30	4.00	5.00
13	4.30	5.10	6.00	5.00	4.50	5.40	5.30	5.00	5.50	6.00	5.30	5.70	5.25
14	5.90	5.30	4.60	7.20	6.00	6.30	6.60	7.00	8.00	7.00	5.40	5.50	6.25
15	5.60	7.00	5.30	8.00	5.20	7.30	7.80	9.00	8.80	8.60	8.30	8.00	7.40
16	6.00	6.60	5.70	7.00	7.30	6.30	6.50	7.10	8.00	6.30	8.00	7.80	6.90
17	7.50	8.00	8.40	8.30	9.00	8.70	8.50	9.00	7.20	8.00	9.00	8.70	8.35
18	8.70	8.50	10.80	9.00	10.50	10.80	11.00	10.00	9.80	10.00	9.00	9.30	9.80
19	9.50	8.00	9.00	11.00	11.30	12.20	10.40	8.60	7.60	8.20	9.00	9.50	9.50
20	9.30	9.10	9.00	9.50	10.50	10.70	10.00	8.30	7.00	9.00	8.00	7.10	8.95
21	7.80	8.40	9.00	6.30	7.20	7.20	5.80	5.10	6.10	5.40	6.50	5.20	6.65
22	6.00	5.20	4.70	7.60	7.80	6.80	6.30	5.80	5.10	5.00	5.50	4.00	5.80
23	5.00	6.00	4.50	7.00	7.50	7.90	8.10	7.50	7.00	6.80	6.60	6.40	6.70
24	6.00	6.00	6.40	6.70	6.80	6.80	7.00	5.50	5.80	6.50	7.50	8.00	6.60
25	8.50	9.00	8.50	8.00	7.50	8.00	8.50	7.50	6.70	7.00	9.00	9.50	8.10
26	7.75	6.50	7.00	7.40	5.40	6.35	7.30	7.60	8.50	7.60	8.50	8.00	7.30
27	7.30	6.00	8.00	8.20	7.60	7.00	6.00	7.00	7.90	8.70	9.50	8.00	7.60
28	7.30	6.90	7.60	8.40	11.20	10.60	9.30	9.50	10.00	9.60	10.00	9.60	8.90
29	9.20	9.10	9.80	9.00	9.20	9.70	9.90	10.00	8.50	9.50	10.00	9.50	9.00
30	9.10	9.30	8.10	8.30	7.60	7.30	6.00	6.90	6.70	7.00	7.80	7.90	7.30
31	7.40	6.70	6.00	7.00	7.30	7.10	6.70	6.00	5.20	4.70	5.20	5.20	6.50
32	5.60	6.10	4.70	4.70	4.20	4.10	3.80	3.80	3.80	3.50	3.85	3.80	4.15
33	3.45	3.75	3.95	4.10	4.30	4.35	4.40	4.40	3.70	3.85	4.20	4.20	4.20
34	4.20	4.75	4.60	3.80	3.70	3.70	3.55	3.55	3.35	3.30	3.35	4.65	3.75
35	5.50	5.20	5.00	5.00	4.50	4.70	4.30	4.30	4.30	6.00	6.00	6.00	5.00
36	6.90	6.90	6.00	6.00	6.00	5.60	5.60	5.70	5.50	5.00	6.00	5.10	5.80
37	4.90	5.20	5.20	5.30	6.00	5.60	5.20	5.80	5.80	5.80	5.40	5.40	5.50
38	5.30	5.30	5.30	5.30	5.90	5.90	5.50	5.20	5.00	5.20	5.20	5.00	5.60
39	5.00	5.00	5.40	5.70	5.70	5.70	5.70	5.50	5.60	5.50	5.50	5.50	5.50
40	5.60	5.60	5.70	5.70	5.70	5.60	5.50	5.60	5.30	5.20	5.40	5.20	5.60
41	5.40	5.30	5.60	5.70	6.00	6.00	5.90	6.00	6.20	6.20	6.40	6.70	6.00
42	6.90	6.30	6.00	7.00	7.40	7.50	7.30	7.30	7.00	7.20	7.20	7.30	7.30
43	7.30	8.00	8.10	8.20	7.80	8.60	9.60	8.90	8.50	9.00	9.00	8.60	8.40
44	8.70	8.90	8.70	8.70	8.00	8.40	8.40	8.90	8.60	8.00	8.00	8.00	8.40
45	8.90	9.40	10.00	9.80	9.80	9.80	9.70	9.60	9.40	9.20	9.40	9.40	9.70
46	9.40	9.80	9.80	10.00	10.10	10.20	11.40	11.20	11.20	12.70	12.70	12.70	11.00
47	12.30	12.40	12.90	11.80	12.10	14.20	14.20	14.00	14.50	13.50	13.90	13.50	13.60
48	13.50	12.60	13.10	13.50	14.10	14.50	16.00	16.50	16.30	15.80	15.40	14.80	15.00
49	14.80	14.80	15.20	16.40	16.40	16.40	16.40	16.30	16.30	16.30	16.50	16.50	16.30
50	16.80	17.30	17.30	18.30	24.60	17.20	16.10	15.00	16.00	16.50	18.30	20.20	17.20
51	20.20	21.80	27.00	24.60	24.30	23.60	23.50	23.00	23.00	23.20	19.20	23.50	23.60
52	23.50	25.00	23.80	23.80	23.90	22.80	22.80	23.20	22.80	19.20	19.20	18.30	22.40
53	19.20	18.00	17.50	18.00	18.00	18.00	19.20	17.40	16.50	15.10	15.10	18.30	17.30
54	16.80	18.00	19.50	19.50	18.00	17.50	17.50	16.00	15.00	15.00	14.50	14.00	17.20
55	16.00	17.70	17.70	19.50	19.00	16.00	18.00	18.00	17.10	17.10	16.90	16.50	18.00
56	16.50	16.50	16.70	16.90	17.00	17.00	16.50	16.00	16.00	16.00	15.50	15.00	16.20
57	16.00	16.00	17.00	18.00	18.00	17.00	17.00	17.50	17.50	17.70	18.60	18.00	17.40
58	18.50	18.50	18.50	17.50	17.70	17.70	18.00	18.50	18.50	18.70	18.70	18.00	18.20
59	17.50	17.50	18.00	18.20	18.50	18.00	17.60	17.50	17.30	17.00	17.00	16.50	17.55[1]

---

[1] Simple average of the 12 monthly prices.

Table 7. Farm chickens: Mid-month prices per pound received by Louisiana farmers, 1910-1959

Year	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	Weight avg.
						---------- cents per pound ----------							
1910	11.9	12.2	12.6	12.8	13.4	13.6	13.0	13.2	13.4	13.4	13.4	13.1	13.
1911	12.8	13.0	12.9	13.1	13.6	13.4	12.7	13.2	13.9	14.0	13.9	13.8	13.
1912	13.8	13.4	12.4	12.2	12.5	12.2	13.1	13.8	13.9	13.6	12.6	12.6	13.
1913	13.0	12.7	12.6	12.8	12.8	13.2	14.5	13.7	13.6	13.1	13.6	13.7	13.
1914	14.0	13.7	14.1	13.8	13.9	14.8	15.0	14.1	12.8	14.4	13.1	13.9	14.
1915	11.9	12.5	13.8	13.7	12.9	13.1	13.3	12.6	12.7	12.4	14.5	13.5	13.
1916	14.2	13.8	11.7	12.8	12.5	13.1	12.8	13.0	14.1	15.2	14.1	16.3	13.
1917	14.6	14.0	14.6	16.0	16.0	18.2	16.9	15.9	18.7	16.5	17.4	18.0	16.
1918	16.4	17.5	17.2	16.8	19.0	18.5	22.3	22.0	21.8	21.7	23.0	22.2	19.
1919	23.4	22.0	20.0	18.5	22.5	23.5	24.0	27.0	30.0	26.0	25.0	26.0	24.
1920	26.0	25.3	23.3	26.5	26.4	27.7	29.2	28.6	25.7	24.0	23.5	25.0	25.
1921	25.0	24.0	24.7	22.9	21.0	25.0	23.0	19.0	22.0	21.0	21.1	19.8	22.
1922	21.1	18.2	18.5	18.4	14.5	22.6	19.5	20.3	22.1	21.0	21.2	23.3	20.
1923	20.0	19.0	20.4	19.0	18.0	23.0	25.0	21.0	24.9	25.0	22.4	22.7	21.
1924	21.0	23.0	21.0	20.7	22.0	22.4	21.5	22.0	24.0	24.0	22.4	22.3	22.
1925	22.0	21.4	21.3	21.2	24.8	25.6	22.5	21.5	22.6	21.8	22.9	22.8	22.
1926	20.4	20.2	21.6	22.2	23.8	24.7	24.0	25.0	25.0	25.0	24.1	22.0	23.
1927	23.2	22.6	22.0	23.9	24.3	23.8	22.6	23.0	23.0	22.8	23.9	22.0	23.
1928	22.0	21.4	22.3	22.7	22.8	23.4	24.0	23.2	24.1	23.5	23.6	23.4	23.
1929	23.0	22.6	22.3	22.8	24.4	24.8	24.1	23.2	23.3	22.8	23.1	22.7	23.
1930	21.9	22.4	21.6	21.8	21.9	22.2	19.4	19.5	19.1	19.0	17.7	16.8	20.
1931	16.7	16.2	16.9	17.9	17.7	18.4	16.8	16.0	15.5	15.1	15.8	14.9	16.
1932	14.1	13.9	12.6	12.9	13.8	12.6	11.9	10.9	11.9	12.3	11.4	11.1	12.
1933	10.6	10.3	9.8	10.5	11.5	11.5	11.2	11.0	11.0	10.4	10.6	10.2	10.
1934	11.1	11.4	11.0	11.9	12.6	12.9	12.6	11.8	13.0	12.7	13.0	13.0	12.
1935	13.2	13.3	13.6	15.0	15.2	15.8	14.9	14.4	15.8	15.5	16.8	17.0	14.
1936	16.2	15.7	16.6	16.5	16.8	16.6	16.4	16.2	16.2	15.8	15.7	15.8	16.
1937	15.3	14.5	15.0	15.5	15.8	15.8	15.3	15.5	16.4	16.6	15.7	16.0	15.
1938	15.5	15.6	15.6	16.2	16.6	16.3	15.2	14.6	15.3	15.2	15.2	15.4	15.
1939	14.7	14.5	15.1	15.9	15.8	15.7	15.4	15.3	15.6	15.6	15.0	14.5	15.
1940	14.2	15.0	14.3	14.8	16.6	16.4	15.6	14.6	15.1	15.6	15.5	15.9	15.
1941	15.0	15.2	15.6	16.5	17.6	17.7	18.0	17.5	18.3	18.3	19.2	19.4	17.
1942	19.2	19.7	19.8	21.1	22.1	22.0	22.0	21.4	22.2	23.1	23.6	23.9	22.
1943	24.1	25.5	27.1	30.1	30.5	30.0	30.0	28.9	28.9	29.2	28.8	28.7	28.
1944	28.9	27.7	27.7	27.7	28.0	28.0	28.2	28.7	28.8	28.2	29.2	29.4	28.
1945	29.2	29.0	29.7	29.7	31.1	31.7	33.2	34.2	34.2	32.0	33.0	35.1	31.
1946	33.8	33.1	32.0	33.0	33.0	34.0	37.0	37.0	35.0	35.0	35.0	35.0	34.
1947	35.0	35.0	34.0	35.7	37.3	38.3	38.0	37.0	39.6	36.7	34.6	36.6	36.
1948	36.6	36.6	36.3	36.5	37.0	36.4	37.5	40.0	35.3	38.5	36.7	39.3	37.
1949	37.9	35.7	35.7	35.2	37.0	36.9	36.2	35.3	35.5	35.1	34.8	34.0	35.
1950	31.8	31.4	33.2	33.1	34.2	30.6	31.3	32.5	33.7	33.3	33.3	31.2	29.
1951	33.3	32.1	35.0	34.0	34.5	34.2	30.6	31.7	31.8	27.9	32.0	30.2	29.
1952	34.7	33.5	30.9	26.8	27.3	27.3	30.3	31.2	31.4	29.8	30.9	33.1	29.
1953	30.6	35.6	28.3	28.7	27.8	26.7	27.6	27.6	26.9	28.4	26.9	30.3	29.
1954	27.0	27.0	25.0	25.0	25.0	25.0	24.0	24.0	24.0	23.0	23.0	22.0	24.
1955	24.5	25.0	25.0	25.5	25.0	24.0	26.0	25.5	24.5	24.5	23.5	23.5	24.
1956	25.0	25.0	25.0	24.0	24.0	23.0	23.0	23.0	22.0	23.0	23.0	23.0	22.
1957	22.5	22.5	22.5	21.0	21.0	21.0	21.0	20.5	22.0	20.5	21.5	21.0	21.
1958	20.5	20.5	21.0	21.0	20.5	20.5	20.5	18.5	18.5	18.0	15.5	15.0	19.
1959	17.0	16.0	16.5	16.5	15.0	15.0	15.0	14.5	14.0	15.0	15.0	15.5	15.

1/ Simple average of the 12 monthly prices.

Table 8. Commercial broilers: Mid-month prices per pound received by Louisiana farmers, 1954-1959

ear	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	Weighted avg.
						cents per pound							
954	25.0	23.5	23.0	24.0	23.0	24.0	26.5	25.5	23.0	21.0	21.0	19.0	23.0
955	23.0	24.5	29.5	28.5	28.0	21.5	26.5	26.0	25.0	23.5	22.5	18.0	25.3
956	19.5	19.5	21.0	20.0	21.5	21.0	21.0	19.0	17.5	18.0	19.0	17.5	19.6
957	19.5	19.5	19.5	18.5	20.0	21.0	21.0	20.5	17.5	16.5	17.0	16.0	18.8
958	20.0	20.5	22.0	18.5	19.5	21.0	18.5	17.5	17.0	15.0	18.0	18.0	18.0 1/
959	17.0	17.0	17.0	15.5	15.0	15.0	15.0	14.5	14.5	14.0	14.0	17.0	15.6 1/

Table 9. Turkeys: Mid-month prices per pound received by Louisiana farmers, 1930-1959

ear	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	Weighted avg.
						cents per pound							
930	30.0	-	-	-	-	-	-	-	-	21.0	22.0	21.0	29.2
931	23.0	-	-	-	-	-	-	-	-	16.0	19.0	19.0	20.8
932	19.0	-	-	-	-	-	-	-	-	16.0	15.0	15.0	17.6
933	14.0	13.0	13.0	13.0	-	-	-	-	-	14.0	15.0	13.0	14.6
934	14.0	14.0	13.0	-	-	-	-	-	-	15.0	17.0	17.0	14.3
935	17.0	17.0	17.0	18.0	-	-	-	-	-	18.0	21.0	22.0	17.4
936	21.0	19.0	20.0	20.0	-	-	-	17.0	19.0	19.0	19.0	19.0	20.0
937	19.0	18.0	17.0	18.0	19.0	19.0	18.0	18.0	18.0	19.0	20.0	20.0	20.1
938	20.0	19.0	19.0	19.0	18.0	18.0	17.0	18.0	18.0	18.0	18.0	19.0	20.6
939	19.0	19.0	19.0	19.0	19.0	19.0	17.0	18.0	18.0	18.0	18.0	19.0	17.5
940	17.0	17.0	17.0	-	18.0	17.7	17.0	17.0	18.0	18.0	18.0	18.0	18.0
941	18.0	18.0	17.0	18.0	20.0	18.0	20.0	19.0	20.0	19.0	22.0	23.0	22.5
942	21.0	20.0	21.0	23.4	22.8	23.0	22.0	23.0	22.2	24.7	26.6	31.5	29.5
943	30.0	30.0	30.0	32.0	32.0	34.0	33.0	34.0	32.0	31.0	34.0	37.0	36.0
944	37.0	35.0	34.0	33.0	33.0	33.0	31.0	32.0	32.0	33.0	38.0	39.0	37.5
945	40.0	37.0	37.0	35.0	36.0	36.0	36.0	39.0	39.0	38.0	39.0	40.0	39.4
946	40.0	37.0	37.0	35.0	37.0	37.0	38.0	36.0	37.0	39.0	45.0	41.0	42.2
947	39.0	37.0	37.0	37.0	37.0	37.0	37.0	37.0	42.0	42.0	42.5	47.5	45.7
948	47.5	46.0	44.0	41.0	42.0	42.0	42.0	43.0	40.0	45.0	47.0	54.0	50.9
949	49.0	46.0	45.0	45.0	43.0	41.0	41.0	40.0	44.0	43.0	44.0	44.5	44.1
950	44.0	40.0	40.0	43.5	45.0	41.0	43.0	40.0	45.0	45.0	45.0	46.5	44.9
951	45.0	45.0	45.0	45.0	45.0	45.0	45.0	45.0	43.0	44.0	45.0	48.0	46.7
952	47.0	45.0	45.0	44.0	42.0	24.0	42.0	42.0	45.0	45.0	45.0	45.0	44.8
953	45.0	45.0	43.0	45.0	44.0	40.0	38.0	38.0	39.0	39.0	40.0	45.0	40.1
954	39.0	39.0	36.0	36.0	36.0	35.0	35.0	35.0	35.0	35.0	36.0	36.0	35.9
955	37.0	37.0	37.0	38.0	37.0	36.0	38.0	36.0	38.0	38.0	37.0	37.0	37.1
956	37.0	36.0	36.0	36.0	36.0	35.0	36.0	36.0	35.0	36.0	35.0	37.0	35.9
957	38.0	38.0	38.0	35.0	35.0	34.0	34.0	34.0	37.0	33.0	37.0	33.0	33.3
958	37.0	38.0	34.0	33.0	33.0	32.0	32.0	32.0	32.0	32.0	26.0	26.0	27.4 1/
959	26.0	26.0	26.0	26.0	26.0	26.0	26.0	26.0	26.0	25.0	26.0	29.0	26.2 1/

1/ Simple average of the 12 monthly prices.

Table 10. Eggs: Mid-month prices per dozen received by Louisiana farmers, 1910-1959

Year	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	Weighte avg.
						---------- cents per dozen ----------							
1910	25.0	22.0	19.0	18.0	18.0	18.0	17.0	18.0	19.0	22.0	24.0	26.0	20.5
1911	24.0	20.0	16.0	16.0	15.0	14.0	15.0	16.0	18.0	20.0	22.0	24.0	18.
1912	25.0	22.0	18.0	16.0	15.0	14.0	16.0	16.0	18.0	21.0	24.0	25.0	19.2
1913	24.0	20.0	18.0	15.0	16.0	16.0	17.0	20.0	23.0	22.0	27.0	30.0	20.7
1914	26.0	22.0	17.0	16.0	17.0	17.0	16.0	17.0	23.0	22.0	21.0	28.0	20.2
1915	25.0	20.0	14.0	15.0	14.0	15.0	14.0	16.0	19.0	24.0	23.0	26.0	18.8
1916	26.0	18.0	16.0	16.0	15.0	16.0	16.0	18.0	21.0	25.0	28.0	34.0	20.8
1917	28.0	28.0	21.0	20.0	23.0	25.0	23.0	25.0	29.0	35.0	37.0	43.0	28.1
1918	41.0	39.0	25.0	27.0	27.0	25.0	27.0	30.0	32.0	37.0	43.0	45.0	33.2
1919	49.0	38.0	29.0	31.0	31.0	31.0	34.0	38.0	42.0	45.0	47.0	52.0	38.9
1920	56.0	47.0	36.0	35.0	35.0	35.0	34.0	41.0	41.0	49.0	51.0	61.0	43.1
1921	48.0	28.0	27.0	18.0	18.0	20.0	21.0	23.0	28.0	30.0	35.0	42.0	28.2
1922	31.0	29.0	16.0	19.0	18.0	20.0	21.0	23.0	29.0	31.0	37.0	40.0	26.2
1923	35.0	32.0	23.0	22.0	22.0	24.0	24.0	25.0	30.0	35.0	40.0	46.0	29.8
1924	39.0	37.0	22.0	21.0	22.0	22.0	23.0	24.0	30.0	38.0	37.0	47.0	26.8
1925	43.0	38.0	23.0	33.0	23.0	23.0	24.0	29.0	36.0	39.0	41.0	49.0	29.6
1926	40.0	32.0	23.0	22.0	24.0	24.0	25.0	26.0	33.0	36.0	38.0	45.0	28.6
1927	39.0	29.0	18.0	20.0	18.0	20.0	22.0	25.0	31.0	35.0	37.0	42.0	25.2
1928	40.0	26.0	24.0	22.0	22.0	23.0	25.0	27.0	32.0	36.0	39.0	40.0	27.1
1929	34.0	27.0	27.0	21.0	22.0	23.0	25.0	28.0	33.0	37.0	38.0	46.0	28.2
1930	41.0	34.0	21.0	22.0	21.0	21.0	21.0	22.0	26.0	28.0	29.0	32.0	25.1
1931	25.0	17.0	15.7	16.1	14.1	15.8	15.4	17.0	19.3	21.8	24.2	25.7	17.7
1932	20.8	12.1	9.3	10.0	9.1	9.8	9.6	12.0	17.0	19.6	22.8	26.7	13.2
1933	23.4	10.4	8.5	8.7	9.8	10.0	12.4	15.6	18.1	18.7	20.9	23.7	13.
1934	19.3	16.8	11.8	11.8	11.9	13.5	14.7	15.8	22.1	23.1	24.3	28.7	16.2
1935	24.4	24.4	15.6	17.4	19.1	18.4	19.1	21.1	24.0	26.0	27.4	31.8	21.2
1936	24.0	21.3	16.2	15.8	16.2	18.4	19.3	21.6	24.8	26.4	29.5	37.4	21.1
1937	25.5	21.3	17.4	18.0	16.4	17.0	18.5	20.2	23.5	26.1	26.2	30.3	20.5
1938	22.0	15.2	13.7	14.5	15.2	15.3	16.5	18.7	22.2	24.3	25.9	29.3	18.0
1939	21.4	15.9	14.1	13.8	14.2	14.8	16.0	18.0	21.3	22.8	24.6	26.6	16.8
1940	20.7	24.7	13.3	13.3	13.9	13.9	15.0	17.8	20.3	22.2	24.2	27.4	16.8
1941	23.3	16.1	14.5	18.0	17.1	19.2	23.6	25.5	29.6	32.6	35.7	42.1	21.9
1942	32.7	25.0	21.9	23.6	23.7	25.5	26.2	26.9	32.8	37.3	39.7	43.3	27.1
1943	39.5	34.5	31.4	31.9	31.9	31.9	32.8	34.6	39.9	45.1	48.4	51.0	35.
1944	47.5	33.1	30.0	24.1	26.4	27.6	27.8	29.7	35.0	41.5	46.8	49.7	31.7
1945	49.0	36.0	29.0	30.0	31.0	32.0	35.0	39.3	44.1	49.2	53.0	58.0	36.
1946	53.0	39.0	29.0	29.0	32.0	34.0	41.0	45.0	51.0	54.0	58.0	57.6	39.0
1947	54.1	47.5	38.7	38.5	38.8	40.2	43.5	49.2	56.9	62.0	62.0	68.5	46.
1948	65.1	56.2	42.4	40.6	40.2	41.7	42.8	48.5	46.7	55.8	60.9	64.2	47.6
1949	56.6	47.5	38.6	38.2	38.4	38.9	42.3	46.7	54.0	58.3	61.6	60.9	45.6
1950	42.9	34.3	31.1	31.2	40.0	32.3	36.4	42.6	48.1	50.4	52.7	71.0	38.1
1951	57.0	49.0	40.3	40.0	41.2	42.1	45.8	48.8	54.1	61.8	56.0	69.6	48.7
1952	55.2	41.9	35.3	37.0	35.5	37.5	43.5	49.8	53.8	56.0	59.0	62.0	44.5
1953	57.0	46.0	43.0	41.0	42.0	44.0	47.0	49.5	52.5	57.5	60.0	62.0	48.1
1954	58.8	53.4	41.7	38.2	39.2	40.3	40.2	44.0	45.0	46.1	46.8	50.0	44.
1955	45.0	45.0	41.5	38.1	37.0	38.4	39.6	43.3	46.9	48.8	51.6	54.4	43.
1956	53.4	48.9	41.4	39.6	38.4	38.0	40.0	43.0	44.0	47.4	49.7	52.7	44.
1957	42.0	42.0	35.4	35.7	34.2	35.8	37.8	42.0	45.0	48.0	52.9	58.0	44.0
1958	52.5	47.5	45.0	45.4	43.9	43.2	41.8	43.9	46.0	49.2	47.3	49.6	47.
1959	47.5	45.2	39.7	37.6	33.8	32.6	36.0	37.3	39.6	42.5	42.5	44.2	39.

1/ Simple average of the 12 monthly prices.

Table 11. Wool: Mid-month prices per pound received by Louisiana farmers, 1910-1959

Year	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	Weighted avg.
					---------- cents per pound ----------								
1910	23	24	22	20	25	22	23	21	16	19	18	17	22
1911	14	18	17	18	17	14	14	15	17	15	15	15	16
1912	15	15	16	14	15	17	16	16	18	16	15	13	16
1913	16	15	13	15	13	12	15	15	15	15	13	14	14
1914	15	14	14	14	10	16	16	15	17	18	14	14	14
1915	16	14	15	16	14	16	15	17	13	17	14	16	15
1916	17	18	14	16	23	25	20	22	20	18	18	18	21
1917	17	19	22	27	30	38	45	43	43	36	35	42	35
1918	38	42	37	39	44	44	48	46	47	50	50	46	44
1919	44	40	39	38	37	36	37	35	38	39	40	35	37
1920	34	34	34	34	33	25	21	19	18	13	10	10	28
1921	10	10	11	15	10	12	10	10	11	14	11	11	12
1922	13	12	11	12	16	16	15	15	14	18	16	18	15
1923	23	18	18	19	20	21	22	24	25	28	31	34	20
1924	30	30	30	30	28	28	26	33	34	33	35	36	28
1925	37	38	39	40	40	40	37	35	35	35	35	36	39
1926	38	36	33	30	25	25	27	28	30	30	34	28	27
1927	30	31	30	26	26	26	28	28	30	31	30	29	26
1928	29	31	31	30	32	34	37	37	35	35	34	34	33
1929	34	31	34	34	33	31	29	31	33	32	30	32	32
1930	33	33	28	29	24	20	20	23	21	22	22	20	23
1931	19	18	17	17	15	14	12	12	11	12	13	11	13
1932	10	9	12	9	7	6	6	7	10	10	9	9	7
1933	9	8	8	8	11	18	20	19	19	19	20	20	16
1934	21	22	22	21	21	20	21	20	21	19	21	22	21
1935	20	20	19	17	17	19	22	21	21	21	23	23	20
1936	22	21	21	21	22	24	23	23	24	25	26	26	23
1937	28	28	28	29	31	31	31	35	33	29	29	28	30
1938	27	26	23	21	22	19	19	19	19	20	21	21	20
1939	21	21	21	20	20	22	22	21	24	24	23	23	21
1940	25	24	24	21	25	25	27	27	26	28	29	29	24
1941	28	29	29	32	34	36	36	32	33	34	34	34	34
1942	34	34	34	34	38	38	40	40	40	40	40	40	38
1943	40	40	40	40	42	45	42	42	41	41	41	41	42
1944	43	42	42	42	43	44	46	48	50	48	46	44	48
1945	41	41	42	42	42	42	42	44	46	48	49	51	48
1946	46	48	48	48	48	47	48	48	48	47	47	47	48
1947	45	43	43	43	43	42	43	42	42	45	45	46	43
1948	44	45	45	45	45	46	46	46	42	45	45	45	45
1949	45	47	45	45	43	44	44	43	44	44	45	43	45
1950	43	44	44	46	67	53	55	57	58	60	61	61	55
1951	65	65	75	80	80	90	107	80	75	75	50	72	104
1952	72	65	62	60	55	55	53	51	50	52	50	50	52
1953	50	50	51	50	50	50	57	51	51	51	51	50	57
1954	51	51	51	51	55	51	58	52	52	52	52	52	56
1955	52	48	44	40	39	42	46	38	43	43	41	41	45
1956	37	37	33	35	38	32	40	31	42	44	48	41	39
1957	42	42	48	48	49	45	53	47	50	37	48	43	51
1958	40	46	40	33	30	30	30	30	31	33	43	32	37
1959	41	30	30	32	32	36	42	42	39	38	38	38	36[1/]

[1/] Simple average of the 12 monthly prices.

Table 12. Milk (wholesale): Mid-month prices per hundred pounds received by Louisiana farmers, 1910-1959

Year	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	Weighte avg.
						---------- dollars per hundred pounds ----------							
1910	2.45	2.45	2.45	2.40	2.10	2.05	2.05	2.15	2.25	2.35	2.45	2.50	2.30
1911	2.50	2.50	2.40	2.20	2.05	2.00	2.05	2.15	2.20	2.25	2.55	2.60	2.30
1912	2.60	2.45	2.35	2.30	2.20	2.05	2.05	2.10	2.15	2.35	2.40	2.40	2.30
1913	2.50	2.35	2.30	2.25	2.10	2.05	2.15	2.25	2.35	2.40	2.50	2.50	2.30
1914	2.55	2.40	2.35	2.25	2.10	2.05	2.15	2.25	2.35	2.40	2.50	2.60	2.35
1915	2.70	2.65	2.55	2.55	2.40	2.15	2.25	2.30	2.60	2.65	2.65	2.65	2.50
1916	2.40	2.40	2.40	2.35	2.35	2.30	2.25	2.40	2.50	2.65	2.85	2.85	2.50
1917	2.90	2.90	2.80	2.70	2.65	2.60	2.65	2.70	2.95	3.25	3.40	3.40	2.90
1918	3.65	3.65	3.50	3.30	3.30	3.30	3.30	3.35	3.70	4.35	4.35	4.35	3.70
1919	4.40	4.40	4.35	4.35	4.30	4.30	4.25	4.25	4.35	5.20	5.20	5.20	4.55
1920	5.20	5.20	5.15	5.15	4.20	4.20	4.15	4.15	5.05	5.10	5.10	4.35	4.75
1921	4.35	4.30	3.80	3.75	3.75	3.70	3.70	3.75	3.75	3.80	3.10	3.10	3.75
1922	3.15	3.10	3.10	3.05	3.05	3.00	3.00	3.00	3.05	3.10	3.10	3.10	3.05
1923	3.15	3.10	3.10	3.05	3.05	3.00	3.00	3.00	3.05	3.35	3.35	3.35	3.15
1924	3.45	3.35	3.35	3.30	2.85	2.80	2.75	2.75	2.80	2.85	2.90	2.90	3.00
1925	2.95	2.90	2.85	2.80	2.45	2.40	2.35	2.35	2.80	2.90	2.90	2.90	2.70
1926	2.95	2.85	2.85	2.75	2.75	2.70	2.65	2.70	2.80	2.85	2.90	2.90	2.80
1927	2.90	2.85	2.70	2.65	2.65	2.60	2.55	2.60	2.65	2.80	2.80	2.80	2.70
1928	2.85	2.80	2.70	2.65	2.65	2.60	2.55	2.60	2.85	2.85	2.90	2.90	2.75
1929	2.95	2.90	2.90	2.65	2.65	2.55	2.55	2.65	2.80	2.80	2.85	2.85	2.75
1930	2.85	2.70	2.65	2.45	2.45	2.40	2.40	2.40	2.50	2.60	2.65	2.65	2.55
1931	2.60	2.45	2.20	2.15	1.95	1.90	1.95	1.95	2.00	2.05	2.05	1.95	2.10
1932	1.85	1.75	1.45	1.35	1.35	1.25	1.25	1.30	1.35	1.45	1.50	1.50	1.45
1933	1.45	1.30	1.25	1.15	1.15	1.15	1.55	1.60	1.65	1.75	1.90	1.95	1.50
1934	1.65	1.65	1.60	1.45	1.40	1.40	1.50	1.75	1.90	2.00	2.05	2.05	1.70
1935	2.15	2.15	2.00	1.85	1.80	1.80	1.85	1.90	1.95	2.05	2.05	2.15	1.95
1936	2.15	2.05	2.05	1.95	1.85	1.95	1.95	2.15	2.25	2.30	2.35	2.35	2.10
1937	2.35	2.30	2.30	2.25	2.15	2.10	2.15	2.20	2.25	2.35	2.40	2.40	2.25
1938	2.45	2.40	2.30	2.15	2.10	2.05	2.00	2.05	2.05	2.10	2.20	2.40	2.15
1939	2.20	2.15	2.10	1.90	1.85	1.85	1.95	1.95	2.15	2.25	2.25	2.40	2.10
1940	2.40	2.35	2.30	2.20	2.15	2.15	2.15	2.20	2.30	2.40	2.45	2.45	2.30
1941	2.40	2.35	2.30	2.25	2.25	2.25	2.25	2.40	2.60	2.65	2.80	2.80	2.45
1942	2.85	2.95	2.90	2.80	2.65	2.65	2.75	2.90	3.15	3.30	3.45	3.55	3.00
1943	3.50	3.50	3.45	3.55	3.50	3.55	3.60	3.65	3.70	3.75	3.90	3.90	3.65
1944	3.85	3.85	3.80	3.75	3.70	3.65	3.65	3.70	3.80	3.85	3.90	3.90	2.75
1945	3.90	3.85	3.85	3.75	3.75	3.75	3.75	3.75	3.80	3.90	3.95	3.95	3.80
1946	3.85	3.85	3.90	3.85	4.05	4.20	5.05	5.90	6.00	6.10	6.30	6.30	4.93
1947	6.25	6.15	5.85	5.45	5.00	4.80	5.10	5.45	5.90	6.30	6.75	6.85	5.71
1948	6.80	6.60	6.20	5.85	5.75	5.90	6.10	6.10	6.25	6.55	6.95	6.95	6.26
1949	6.70	6.50	5.90	5.35	5.20	5.20	5.20	5.35	5.75	6.15	6.35	6.30	5.75
1950	5.90	5.60	5.40	5.20	5.20	5.10	5.20	5.60	5.95	6.15	6.30	6.30	5.61
1951	6.05	6.00	5.85	5.80	5.75	5.90	5.75	6.10	6.35	6.60	6.95	7.00	6.14
1952	6.70	6.60	6.40	6.15	6.15	6.15	6.30	6.40	6.70	7.05	7.15	7.05	6.55
1953	6.90	6.60	6.10	5.90	5.80	5.75	5.90	6.05	6.30	6.60	6.45	6.45	6.23
1954	6.15	5.85	5.65	5.25	5.30	5.25	5.30	5.45	5.90	5.95	6.05	5.90	5.67
1955	5.75	5.70	5.40	5.35	5.30	5.25	5.45	5.50	5.80	5.90	6.15	6.05	5.63
1956	5.80	5.80	5.55	5.35	5.50	5.50	5.50	5.60	5.80	6.05	6.05	5.95	5.71
1957	5.90	5.80	5.50	5.30	5.25	5.15	5.40	5.60	5.80	6.05	6.20	5.85	5.63
1958	6.05	6.00	5.55	5.25	5.20	4.90	5.10	5.40	5.85	5.75	5.90	5.80	5.56
1959	5.90	5.75	5.40	5.40	5.25	5.15	5.30	5.45	5.60	5.80	5.75	5.90	5.55

1/ Simple average.

Table 13. Milk (retail): Mid-month prices per quart received by Louisiana farmers, 1910-1959

ar	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	Weighted avg.
				---------- cents per quart ----------									
10	9.4	9.2	9.0	8.8	8.6	8.6	8.8	9.0	9.2	9.4	9.4	9.4	9.1
11	9.4	9.2	9.0	8.0	8.6	8.6	8.8	9.0	9.2	9.4	9.4	9.2	9.0
12	9.4	9.2	9.0	8.8	8.6	8.6	8.8	9.0	9.2	9.4	9.4	9.4	9.1
13	9.2	9.0	8.5	8.4	8.2	8.2	8.4	8.8	8.8	8.8	9.5	9.0	8.7
14	9.0	9.0	8.8	8.6	8.4	8.4	8.4	8.8	9.0	9.2	9.4	9.4	8.9
15	9.4	9.2	9.2	8.5	8.4	8.6	9.0	9.0	9.0	9.0	9.5	9.4	9.0
16	9.2	9.2	8.8	8.6	8.4	8.2	8.5	8.8	9.0	9.0	9.2	9.8	8.9
17	9.8	9.8	9.8	10.0	10.2	9.5	10.0	10.5	10.8	11.5	11.6	12.0	10.5
18	12.0	12.0	11.8	11.8	11.5	11.5	11.8	11.8	12.0	12.8	13.2	13.6	12.2
19	13.2	12.8	12.8	12.8	12.8	12.8	12.8	13.2	14.0	14.2	15.0	15.2	13.5
20	16.2	15.2	15.0	15.0	15.0	15.0	15.5	15.6	15.8	17.0	16.8	16.2	15.7
21	15.2	14.8	14.6	13.8	13.0	13.0	12.8	11.5	11.8	11.8	13.5	12.8	13.2
22	12.6	12.5	12.2	11.8	11.2	11.2	11.8	12.0	12.2	12.2	12.5	12.6	12.1
23	12.6	13.5	12.2	12.0	11.8	11.8	11.8	11.4	11.6	11.8	12.9	13.6	12.2
24	13.7	13.8	14.0	12.0	11.3	11.4	11.6	11.6	12.3	13.0	13.3	12.7	12.6
25	12.2	12.1	12.0	11.4	11.4	11.5	12.0	12.0	12.8	13.2	13.4	13.4	12.3
26	13.4	13.6	13.2	12.6	12.6	12.0	13.0	13.1	13.2	13.2	13.2	13.4	13.0
27	13.6	13.6	13.6	13.3	13.2	13.2	13.3	13.3	13.4	13.4	13.6	13.6	13.4
28	13.6	13.6	13.6	13.4	13.3	13.0	13.0	13.9	13.1	13.3	13.6	13.6	13.4
29	13.9	13.4	13.3	13.3	12.7	12.6	12.6	12.8	12.8	12.8	13.0	13.9	13.0
30	13.2	13.1	13.0	13.0	12.4	13.0	13.0	12.8	12.6	12.4	12.4	12.3	12.8
31	12.3	11.7	11.7	11.3	11.3	11.0	11.0	11.0	10.8	10.8	10.8	10.6	11.2
32	10.1	10.0	10.0	10.0	9.6	9.0	8.5	8.9	8.9	8.9	8.8	8.8	9.3
33	9.0	9.0	9.0	8.4	8.4	8.2	9.2	10.0	10.0	10.0	10.0	10.0	9.3
34	9.8	9.6	9.0	9.0	9.2	9.1	9.0	9.4	9.5	9.5	9.9	9.9	9.5
35	9.9	10.2	10.3	10.1	10.1	9.5	9.4	9.4	9.5	9.5	9.5	9.6	9.8
36	9.6	9.5	9.5	9.5	9.5	9.8	9.8	9.8	9.8	10.5	10.5	10.5	9.9
37	10.5	10.3	10.2	10.2	10.2	10.0	10.1	10.1	10.1	10.0	10.1	10.3	10.2
38	10.3	10.3	10.0	9.6	9.6	9.4	9.5	9.6	9.4	9.4	9.5	9.6	9.7
39	9.6	9.6	9.6	9.6	9.6	9.7	9.8	9.9	10.0	10.1	10.2	10.2	9.8
40	10.1	10.1	10.1	10.1	10.0	10.0	9.9	9.9	10.0	10.0	10.2	10.2	10.0
41	10.2	10.2	10.1	10.1	10.1	10.1	10.2	10.4	11.4	11.4	11.4	11.5	10.6
42	11.7	11.3	11.4	11.4	11.5	11.7	11.7	11.7	11.9	11.9	12.1	12.3	11.7
43	12.4	12.6	12.8	12.9	12.4	12.8	12.8	12.8	12.9	13.0	13.0	13.0	12.8
44	13.0	13.0	13.0	13.0	12.7	12.5	13.0	13.1	13.1	13.2	13.2	13.3	13.0
945	13.3	13.3	13.3	13.3	13.2	13.2	13.3	13.4	13.5	13.5	13.5	13.6	13.4
946	13.6	13.6	13.6	13.6	13.6	14.0	15.2	15.3	16.3	17.0	17.5	17.5	15.1
947	17.5	17.5	17.5	17.4	17.4	17.4	17.5	17.5	18.0	18.5	19.0	19.0	17.8
948	20.0	20.0	20.0	19.2	18.8	19.0	19.0	20.0	19.3	20.0	20.0	20.0	19.7
949	20.0	19.5	19.5	19.5	19.0	19.0	19.0	19.3	19.4	19.9	20.5	20.3	19.6
950	20.3	20.3	20.1	19.6	21.4	19.6	19.6	20.3	20.8	20.8	20.8	21.0	20.2
951	21.0	21.5	21.5	21.4	21.2	20.8	21.3	21.4	21.6	21.8	22.5	22.5	21.5
952	22.2	22.8	22.3	22.0	22.0	22.0	22.4	22.5	22.5	22.5	23.0	23.0	22.4
953	23.0	23.0	22.8	22.6	22.2	22.2	22.2	22.2	22.2	22.2	22.2	23.0	22.4
954	22.1	22.1	22.1	21.9	21.6	22.0	22.0	22.1	22.3	22.5	22.6	22.6	22.2
955	22.4	22.4	22.4	22.4	22.4	22.5	22.4	23.0	23.7	23.1	23.6	23.6	22.8
956	23.0	22.7	22.6	22.6	22.5	22.4	22.7	22.4	22.8	22.8	23.0	23.3	22.7
957	23.1	23.1	23.0	23.0	23.0	23.0	24.0	23.0	23.0	23.0	23.5	23.0	23.2
958	23.0	23.0	23.5	23.0	22.6	22.6	22.6	23.0	23.0	24.0	24.0	24.0	23.2
959	24.0	24.0	24.0	24.0	24.0	23.0	23.0	23.0	23.5	23.0	23.5	23.5	23.5[1]

/ Simple average of the 12 monthly prices.

Table 14. Butter: Mid-month prices per pound received by Louisiana farmers, 1910-1952

Year	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	Weighte avg.
					---------- cents per pound ----------								
1910	26	27	27	26	26	26	25	25	24	24	26	26	26
1911	26	26	26	25	25	25	24	24	26	26	26	27	26
1912	29	29	28	28	28	26	26	27	27	28	29	30	28
1913	28	28	28	27	28	28	28	28	27	28	28	28	28
1914	28	28	28	28	28	28	28	28	28	28	28	28	28
1915	29	29	28	28	28	28	28	28	28	29	29	30	28
1916	29	28	28	28	28	29	29	29	28	30	32	32	29
1917	33	33	33	34	34	34	34	34	34	36	38	41	35
1918	45	44	40	38	38	38	39	40	42	46	48	52	42
1919	52	48	46	48	51	46	42	44	44	46	52	56	48
1920	54	50	51	50	48	48	48	48	50	52	51	54	50
1921	52	46	44	44	40	36	34	36	38	40	40	40	41
1922	41	38	36	37	36	34	34	34	34	36	38	40	36
1923	40	39	40	40	40	40	38	40	41	42	44	45	41
1924	47	50	46	44	46	42	41	44	45	44	44	48	45
1925	42	40	41	45	45	44	42	41	45	44	47	47	44
1926	43	44	43	42	42	45	41	41	42	42	45	46	43
1927	45	46	43	45	42	43	43	43	45	45	44	47	44
1928	45	44	44	44	44	43	41	42	42	44	43	44	43
1929	41	42	42	43	42	41	42	43	43	43	45	42	42
1930	42	42	42	42	42	41	40	40	39	41	41	38	41
1931	36	34	34	33	32	30	29	28	29	30	29	32	31
1932	29	26	25	25	22	21	21	22	22	22	21	22	23
1933	22	21	20	21	21	22	23	22	22	23	24	24	22
1934	23	24	24	23	23	24	23	24	26	26	27	27	24
1935	28	31	29	29	28	27	27	28	28	28	30	30	28
1936	31	29	29	27	27	27	29	30	29	30	31	32	29
1937	31	29	30	30	30	29	29	29	29	30	31	31	30
1938	30	28	28	28	27	25	25	27	27	28	28	28	27
1939	27	27	26	26	26	26	25	24	26	27	27	27	26
1940	27	27	26	26	27	26	27	27	27	27	27	29	27
1941	29	29	28	28	29	29	31	30	32	32	34	35	31
1942	34	33	33	34	34	34	34	34	36	37	38	42	35
1943	42	44	44	44	44	45	45	45	45	46	48	48	45
1944	47	47	46	46	46	44	44	44	45	45	46	49	45
1945	48	47	47	47	47	47	48	48	48	49	50	50	48
1946	51	51	51	51	51	54	65	65	63	65	71	73	59
1947	68	64	64	63	62	59	60	61	68	68	69	74	64
1948	71	70	67	67	66	64	64	64	66	65	65	66	66
1949	65	63	62	62	61	59	60	60	60	60	62	61	61
1950	60	60	59	58	57	57	57	56	58	60	60	63	58
1951	63	63	61	60	61	60	60	58	60	63	63	63	61
1952	63	63	60	60	1/								

1/ Discontinued.

Table 15. Butterfat: Mid-month prices per pound received by Louisiana farmers, 1910-1959

Year	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	Weighted avg.
						---------- cents per pound ----------							
1910	29	27	28	27	25	25	25	26	26	27	28	26	27
1911	25	24	22	20	19	20	22	22	23	26	29	31	24
1912	32	29	29	28	26	24	23	24	25	26	28	30	27
1913	30	30	31	28	26	25	24	25	28	28	29	30	28
1914	29	27	25	23	24	24	25	26	27	28	29	29	26
1915	29	28	26	27	25	25	24	22	24	26	28	30	26
1916	28	29	29	27	25	25	25	26	27	29	33	33	28
1917	34	35	36	36	33	32	32	33	35	36	37	40	35
1918	42	41	38	36	37	37	38	41	45	50	56	58	43
1919	55	49	52	54	49	47	47	49	52	59	62	64	53
1920	61	60	59	56	54	49	48	50	52	54	55	58	55
1921	57	44	44	44	37	32	31	30	35	40	40	42	40
1922	42	41	37	39	37	35	35	35	35	38	42	43	38
1923	44	44	45	43	42	38	38	39	40	41	42	44	42
1924	44	42	41	40	39	38	37	38	40	40	40	41	40
1925	40	38	38	38	38	37	36	35	36	37	38	40	38
1926	40	39	38	38	38	38	39	39	38	38	42	48	40
1927	42	38	39	42	38	39	40	38	42	44	46	43	41
1928	47	42	39	40	41	43	41	40	42	40	42	39	41
1929	41	43	44	40	41	41	40	42	41	42	39	39	41
1930	38	38	36	36	38	34	36	35	35	35	32	31	35
1931	28	24	27	25	23	23	23	25	23	24	27	21	24
1932	20	19	17	17	15	14	14	14	14	14	14	14	16
1933	15	15	15	15	15	16	17	16	16	17	16	16	16
1934	15	17	17	17	18	18	18	18	19	22	23	22	19
1935	23	28	25	28	25	24	22	22	22	22	22	24	24
1936	26	26	26	26	22	24	29	30	29	27	28	27	27
1937	31	30	30	28	27	28	28	28	28	30	31	31	29
1938	27	27	27	24	21	22	22	22	21	21	21	22	23
1939	21	21	21	20	21	21	20	20	21	21	23	24	21
1940	26	26	24	24	24	24	24	24	25	25	25	27	25
1941	26	26	26	26	30	30	30	30	31	31	33	34	30
1942	33	32	32	32	33	33	33	33	34	35	36	40	34
1943	41	41	40	40	40	39	39	41	41	43	45	45	41
1944	45	45	45	45	44	43	43	43	45	45	47	47	45
1945	47	47	47	46	46	46	47	47	47	48	48	48	47
1946	47	47	47	47	47	47	55	55	57	65	71	73	54
1947	65	61	61	61	59	56	56	61	68	68	69	72	62
1948	72	69	67	67	66	64	64	66	58	65	65	66	66
1949	65	63	60	60	59	59	58	58	58	58	60	59	59
1950	58	58	57	56	60	56	55	55	57	59	59	71	57
1951	61	62	61	60	61	60	60	59	60	60	63	62	60
1952	63	64	60	60	60	60	62	62	63	63	63	62	52
1953	62	60	60	58	58	57	58	58	58	60	60	62	59
1954	60	60	58	53	53	52	53	53	54	54	56	54	53
1955	54	52	52	51	51	51	52	52	52	52	52	52	51
1956	51	51	51	51	51	50	50	51	51	52	53	53	51
1957	52	52	51	51	51	50	51	51	51	52	52	53	51
1958	53	53	53	52	52	51	52	52	50	50	50	50	51
1959	50	50	50	50	50	50	50	50	50	50	51	51	50[1]

---

[1] Simple average of the 12 monthly prices.

Table 16. Cotton: Mid-month prices per pound received by Louisiana farmers, 1910-1959

Year	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	Weighte avg.
					---------- cents per pound ----------								
1910	14.4	14.2	14.0	13.8	14.0	13.9	13.7	13.9	13.6	13.6	14.2	14.4	14.0
1911	14.3	14.1	13.9	13.8	14.1	14.4	13.8	12.9	11.0	9.8	9.0	8.6	9.6
1912	8.6	9.2	9.7	10.5	11.2	11.4	11.8	11.6	11.1	10.8	10.9	12.0	11.
1913	12.2	11.6	11.6	11.8	11.8	11.8	11.8	11.8	12.4	13.2	12.4	11.8	12.
1914	11.7	11.5	11.6	11.8	11.8	12.2	12.4	11.1	9.0	7.1	6.6	6.8	7.6
1915	7.0	7.4	7.7	8.4	8.6	8.2	8.1	8.2	9.4	10.9	11.2	11.2	10.
1916	11.4	11.4	11.3	11.4	11.8	12.2	12.4	13.4	14.6	15.9	18.0	17.9	16.
1917	16.8	16.3	16.6	18.1	19.4	22.4	24.2	23.7	23.4	24.4	26.2	27.6	26.
1918	29.2	30.0	31.0	30.2	28.0	28.0	28.4	29.6	31.1	29.9	28.2	22.7	28.
1919	26.8	25.1	24.2	24.4	27.5	30.6	31.7	31.1	30.8	33.7	35.4	37.0	35.
1920	37.9	37.4	38.4	39.3	39.3	39.0	38.4	34.0	37.0	21.2	16.2	13.0	16.
1921	12.2	11.8	10.2	9.4	9.6	9.4	9.2	10.0	14.5	17.8	16.2	15.2	15.
1922	15.2	14.8	15.2	15.2	16.3	19.0	20.2	20.3	19.6	20.2	22.8	23.8	22.
1923	24.6	26.4	28.0	27.8	25.7	24.8	24.0	23.2	25.2	27.3	29.0	32.0	27.
1924	32.0	31.0	27.0	29.0	28.3	27.0	26.8	27.0	22.0	22.0	21.0	21.7	22.
1925	21.8	22.3	23.1	22.5	22.1	23.0	23.0	22.5	21.7	20.8	18.1	17.4	19.
1926	17.6	16.0	15.9	16.0	15.8	16.1	15.1	15.3	16.6	11.2	10.6	10.2	12.
1927	10.3	12.0	12.4	12.9	14.2	14.9	15.3	16.9	22.7	20.3	19.4	18.3	19.
1928	18.3	17.0	17.4	18.1	19.6	19.3	20.3	18.8	17.2	17.8	17.6	17.8	17.
1929	17.8	17.7	18.7	18.1	17.7	17.4	17.3	17.1	17.9	17.1	16.2	16.1	16.
1930	16.0	14.9	13.6	14.2	14.2	13.7	11.7	11.2	9.8	9.0	9.3	8.7	9.
1931	8.6	8.9	9.2	9.2	8.6	7.5	8.5	6.0	5.7	5.0	6.0	5.5	5.
1932	5.6	5.6	6.3	5.7	5.1	4.5	5.0	6.3	7.3	6.7	6.0	5.5	6.
1933	5.7	5.6	6.2	6.2	8.1	8.6	10.3	8.7	8.9	9.0	9.4	9.4	10.
1934	9.8	11.5	11.8	11.6	11.0	11.5	12.2	13.0	13.2	12.5	12.4	12.4	12.
1935	12.2	12.0	11.5	11.6	12.1	11.6	11.7	11.3	10.5	11.0	11.4	11.1	11.
1936	11.0	11.0	11.0	11.2	11.3	11.3	12.3	12.3	12.6	12.3	12.3	12.5	12.
1937	12.4	12.4	13.3	13.8	12.8	12.0	12.2	10.7	8.9	8.0	7.5	7.6	8.
1938	7.7	8.1	8.3	8.3	8.4	7.9	8.2	8.1	8.3	8.5	8.4	8.3	8.
1939	8.3	8.2	8.3	7.9	8.4	8.4	8.6	8.6	9.1	8.6	8.8	9.6	9.
1940	9.9	9.8	9.8	9.7	9.7	9.3	9.4	9.2	9.2	9.4	9.4	9.2	9.
1941	9.5	9.4	9.9	10.5	11.4	12.4	14.0	14.9	17.4	16.7	16.1	16.6	17.
1942	18.2	18.4	18.5	19.6	19.2	18.4	18.6	18.0	18.5	18.5	18.5	18.5	18.
1943	19.3	19.3	19.5	19.9	19.9	19.9	19.9	20.1	20.2	19.7	18.9	18.4	19.
1944	18.7	19.3	19.7	20.0	20.0	20.0	20.6	20.4	20.9	21.0	20.8	20.5	20.
1945	20.7	20.6	20.5	20.8	21.2	21.5	21.5	21.6	21.8	22.6	22.6	22.6	22.
1946	23.1	23.3	24.3	24.9	25.7	26.5	30.1	33.4	35.3	37.0	30.0	31.0	33.
1947	33.0	31.6	33.3	33.3	33.6	34.7	36.3	34.7	32.1	31.2	31.8	34.2	32.
1948	34.5	32.3	33.3	35.0	35.0	35.4	34.0	36.6	30.2	31.2	30.7	30.9	31.
1949	31.2	30.0	29.6	30.2	31.2	31.0	31.0	30.2	30.7	29.5	27.3	26.7	29.
1950	38.0	28.7	29.8	30.2	30.5	32.0	33.4	37.0	41.0	39.5	39.9	41.3	40.
1951	41.2	42.8	43.0	43.5	42.9	42.2	39.8	28.0	34.5	35.2	39.5	40.2	37.
1952	39.9	39.7	38.6	40.0	38.0	40.0	38.8	39.4	39.9	37.5	35.3	33.6	36.
1953	32.2	32.8	33.2	32.6	33.0	33.1	33.0	33.2	33.4	33.2	32.8	33.6	33.
1954	32.4	32.7	33.3	33.0	33.3	33.3	33.6	34.4	35.3	34.6	32.8	33.0	33.
1955	32.5	33.0	33.0	33.0	34.0	33.5	34.0	34.0	34.0	32.5	31.5	33.5	32.
1956	31.8	32.6	33.1	33.0	33.5	33.3	32.5	33.3	32.8	32.3	31.0	31.0	32.
1957	32.0	32.0	31.5	32.0	33.0	33.0	33.1	33.4	33.9	31.7	31.2	28.1	30.
1958	27.6	27.7	30.4	30.4	30.0	30.0	30.0	34.0	35.0	30.0	30.0	30.5	32.
1959	30.0	31.0	31.5	31.5	32.5	32.5	32.5	32.5	33.5	33.3	32.8	32.7	33.

Table 17. Cottonseed: Mid-month prices per ton received by Louisiana farmers, 1910-1959

Year	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	Weighted avg.
						---------- dollars per ton ----------							
1910	26.20	26.00	27.00	28.00	28.50	29.00	28.50	25.80	25.80	26.30	24.80	24.90	25.64
1911	26.20	24.50	24.30	24.50	22.50	21.30	21.20	24.00	18.00	17.00	18.90	18.50	18.03
1912	17.10	18.40	18.30	18.10	19.30	17.00	18.30	19.30	18.10	18.40	19.90	19.70	18.79
1913	20.20	21.80	21.50	21.70	22.50	19.60	18.50	20.00	19.70	19.00	18.00	18.50	18.74
1914	17.60	18.00	18.20	20.10	22.10	18.00	20.00	21.00	13.20	16.10	13.60	17.80	15.26
1915	19.00	20.50	20.60	20.20	21.10	19.80	19.00	17.00	21.10	30.60	34.10	34.60	27.26
1916	35.00	40.00	34.80	40.70	32.50	35.00	36.50	36.50	36.50	45.00	57.00	57.00	42.83
1917	50.00	45.30	52.70	55.30	58.40	58.00	54.30	60.00	53.50	62.50	66.30	65.75	60.94
1918	66.25	67.20	68.80	69.00	71.00	68.50	65.00	57.00	67.00	67.00	64.00	61.00	64.69
1919	61.00	61.00	62.10	63.00	63.00	62.40	62.00	63.00	60.00	62.90	69.70	68.60	64.48
1920	66.10	65.00	71.00	75.00	70.80	66.70	65.00	55.40	34.70	27.90	27.80	21.40	29.07
1921	20.40	19.50	19.10	18.70	17.20	18.10	17.50	21.40	26.60	28.00	29.10	24.60	27.39
1922	25.60	25.80	25.50	32.70	33.50	33.40	29.80	25.00	27.00	27.90	34.70	42.60	28.12
1923	38.00	35.00	35.00	38.70	37.80	36.00	38.00	40.00	40.00	40.00	42.00	41.00	40.35
1924	40.00	39.00	45.00	43.00	41.50	40.00	40.00	35.00	31.00	30.00	30.50	32.00	31.18
1925	35.00	33.50	34.00	33.60	35.50	32.00	40.00	32.30	33.20	29.70	24.50	23.00	30.68
1926	25.00	27.80	28.10	27.60	27.10	29.30	32.80	28.00	25.10	18.30	17.70	17.40	21.25
1927	18.10	22.20	23.00	24.40	24.10	24.00	25.00	25.20	33.70	34.60	34.20	36.00	32.77
1928	36.50	35.00	35.00	36.00	39.00	39.00	39.00	37.00	30.00	32.00	35.00	35.00	31.76
1929	35.00	35.00	37.00	36.00	35.00	34.00	33.00	29.00	29.00	31.00	30.00	31.00	29.60
1930	31.00	30.00	31.00	31.00	31.00	29.00	27.00	23.00	23.00	19.00	19.00	19.00	21.28
1931	20.00	20.00	21.00	21.00	21.00	19.00	19.40	13.60	8.00	6.50	8.80	9.10	7.67
1932	9.40	9.30	9.80	9.50	9.20	8.30	8.50	8.50	10.60	10.20	9.30	9.00	10.11
1933	9.10	9.00	9.20	10.00	11.50	12.00	14.00	14.00	11.50	12.75	12.90	13.00	12.20
1934	15.50	16.00	17.75	18.00	19.00	18.50	19.00	25.00	33.00	34.00	36.00	36.00	31.78
1935	38.00	38.00	38.00	36.00	37.00	36.00	36.00	29.00	29.00	33.00	34.00	34.00	30.35
1936	34.00	34.00	34.00	35.00	34.00	33.00	33.00	33.00	34.00	34.00	34.00	35.00	33.77
1937	36.00	37.00	37.00	38.00	38.00	35.00	34.00	24.00	18.00	17.00	18.00	18.00	18.79
1938	17.00	19.00	20.00	20.00	29.00	21.00	21.00	21.00	20.00	22.00	22.20	23.00	20.58
1939	23.00	23.00	22.30	23.00	22.50	23.00	20.50	13.40	20.30	22.20	22.20	23.10	19.24
1940	24.20	24.70	25.20	25.50	25.50	24.40	24.00	22.00	19.70	20.50	22.00	22.80	20.32
1941	24.40	24.00	25.00	26.20	27.80	28.90	34.20	35.60	47.00	52.00	49.00	48.20	47.54
1942	47.90	48.20	48.80	49.20	49.00	46.00	46.00	45.00	44.00	45.00	44.00	44.00	44.44
1943	45.00	45.00	46.00	46.50	47.10	47.30	46.50	51.00	52.00	52.00	51.00	49.00	51.60
1944	50.00	50.00	51.00	51.00	51.00	52.00	53.00	51.00	51.00	49.00	50.00	50.00	50.20
1945	51.00	51.00	51.00	52.00	52.00	53.00	53.00	51.00	49.00	50.00	51.00	52.00	49.80
1946	52.00	51.00	51.00	52.00	52.00	53.00	57.00	58.00	58.00	63.00	91.00	93.00	61.90
1947	91.00	89.00	91.00	90.00	84.00	74.00	74.00	69.00	76.00	89.00	87.00	89.00	79.80
1948	92.00	90.00	89.00	91.00	92.00	90.00	92.00	71.00	45.00	62.00	66.00	69.00	66.70
1949	66.00	55.00	55.00	55.00	55.00	50.00	45.00	45.00	45.00	41.00	36.00	35.50	42.10
1950	38.00	40.00	42.00	43.00	42.50	45.50	48.00	60.00	81.00	79.00	89.00	90.00	79.30
1951	91.00	98.00	95.00	95.00	91.00	90.00	78.00	63.00	65.00	63.00	69.00	67.00	64.10
1952	69.00	70.00	66.00	66.00	64.00	65.00	65.00	65.00	67.00	69.00	70.00	70.00	67.50
1953	69.00	67.00	67.00	66.00	66.00	65.00	63.00	57.00	51.00	53.00	54.00	70.00	52.80
1954	55.00	57.00	57.00	57.00	59.00	55.00	55.00	51.00	62.00	60.00	57.00	59.00	59.30
1955	58.00	60.00	61.00	60.00	60.00	47.00	57.00	52.00	42.00	42.00	43.00	43.00	42.90
1956	45.00	45.00	45.00	47.00	47.00	47.00	48.00	46.00	50.00	55.00	57.00	59.00	51.30
1957	58.00	56.00	1/	-	-	-	-	50.00	53.00	46.00	46.00	46.00	47.70
1958	45.00	46.00	50.00	-	-	-	-	49.00	44.00	38.00	38.00	44.00	40.40
1959	46.00	46.00	45.00	-	-	-	-	44.00	36.00	39.00	39.00	39.00	38.20

1/ Not quoted.

Table 18. Rice: Mid-month prices per hundred pounds received by Louisiana farmers, 1910-1959

Year	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	Weighte avg.
						---------- dollars per hundred pounds ----------							
1910	1.84	1.64	1.51	1.76	1.71	1.53	1.60	1.69	1.38	1.38	1.44	1.49	1.44
1911	1.51	1.40	1.49	1.31	1.42	1.36	1.64	1.69	1.51	1.60	1.67	1.60	1.73
1912	1.76	2.00	2.13	2.22	2.29	2.13	2.58	2.13	2.04	1.60	1.93	2.04	1.96
1913	2.13	2.18	2.11	1.78	1.84	1.96	2.07	2.24	2.04	1.91	2.40	1.64	1.93
1914	1.87	1.62	1.33	1.58	1.89	1.87	2.04	2.60	2.33	1.60	1.64	2.04	1.98
1915	1.91	2.16	2.20	2.24	2.16	2.16	2.04	1.93	1.71	1.60	1.91	1.69	1.80
1916	1.67	2.02	2.16	2.20	1.64	2.02	1.87	2.36	1.84	1.91	2.09	2.00	2.11
1917	2.00	2.13	2.22	3.00	3.82	3.31	3.87	4.00	3.93	3.60	4.13	4.27	4.20
1918	4.36	4.60	5.02	4.64	5.16	4.76	4.29	4.33	4.20	3.76	3.67	3.76	3.84
1919	3.40	4.00	4.09	3.69	4.44	5.20	5.98	7.91	5.76	5.07	5.13	5.07	5.53
1920	6.38	6.18	6.38	5.82	5.38	6.00	4.68	3.82	3.51	2.84	2.84	2.22	2.51
1921	1.80	1.76	1.82	1.69	1.87	1.73	1.67	2.13	2.18	2.16	1.96	1.96	2.13
1922	2.47	2.16	2.40	2.02	1.93	2.20	2.40	2.33	1.80	1.87	2.40	2.16	2.11
1923	2.16	2.07	2.42	2.44	1.96	2.40	2.69	2.29	2.40	2.47	2.38	2.36	2.42
1924	2.44	2.47	2.40	2.49	2.89	3.00	3.04	2.93	2.87	2.84	2.91	3.13	2.93
1925	3.20	3.13	3.09	3.07	3.16	3.31	3.33	3.24	3.18	3.20	3.38	3.40	3.31
1926	3.42	3.33	3.18	2.91	3.04	3.13	3.24	2.58	2.62	2.49	2.47	2.44	2.47
1927	2.47	2.40	2.42	2.33	2.31	2.27	2.31	2.00	2.02	2.09	2.02	2.04	2.04
1928	2.07	1.98	2.00	2.04	2.13	2.18	2.07	2.04	2.04	2.02	2.09	2.11	2.09
1929	2.18	2.13	2.13	2.16	2.07	2.09	2.09	2.22	2.20	2.18	2.20	2.18	2.22
1930	2.22	2.38	2.29	2.38	2.36	2.31	2.20	1.96	1.76	1.71	1.69	1.62	1.71
1931	1.67	1.73	1.69	1.71	1.64	1.64	1.62	1.24	1.04	1.04	1.33	1.31	1.16
1932	1.24	1.18	1.16	1.09	1.09	1.07	1.02	1.04	1.04	.93	.91	.91	.96
1933	.84	.80	.89	1.04	1.24	1.33	1.36	1.44	1.67	1.73	1.78	1.67	1.73
1934	1.73	1.76	1.78	1.80	1.73	1.71	1.67	1.76	1.73	1.84	1.89	1.73	1.82
1935	1.71	1.82	1.89	1.91	1.93	2.00	1.96	1.64	1.22	1.44	1.56	1.64	1.58
1936	1.84	1.89	1.84	1.87	1.98	1.98	2.00	2.02	2.20	1.93	1.87	1.82	2.00
1937	2.04	2.16	2.18	2.22	2.11	1.98	1.89	1.69	1.44	1.78	1.84	1.51	1.53
1938	1.60	1.47	1.40	1.27	1.29	1.40	1.42	1.42	1.33	1.44	1.53	1.44	1.44
1939	1.47	1.53	1.44	1.42	1.42	1.42	1.40	1.29	1.98	1.69	1.73	1.64	1.64
1940	1.67	1.53	1.44	1.44	1.67	1.67	1.76	1.76	1.42	1.56	1.78	1.84	1.89
1941	2.13	2.36	2.33	2.78	2.78	2.69	2.60	2.36	1.93	2.13	2.84	3.31	2.96
1942	3.51	3.69	3.96	4.04	4.04	3.82	3.78	3.56	3.56	3.27	3.44	3.78	3.60
1943	4.00	4.00	4.04	4.16	4.09	4.09	4.00	3.60	3.58	3.87	4.27	4.22	4.02
1944	4.31	4.36	4.22	4.24	4.00	3.87	3.85	3.67	3.58	4.07	4.11	4.18	3.98
1945	4.11	4.11	4.11	4.11	4.11	4.11	4.11	3.67	3.69	3.96	4.22	4.11	4.07
1946	4.11	4.00	4.33	4.33	4.44	4.44	4.44	3.89	4.38	5.24	5.51	5.56	5.13
1947	5.22	6.00	6.00	5.78	5.78	5.47	6.22	6.27	5.16	5.40	5.89	6.02	5.73
1948	6.60	7.10	6.80	6.90	6.80	7.00	6.90	5.55	4.40	4.75	5.30	5.40	4.87
1949	5.11	4.73	4.56	4.71	4.56	4.56	4.22	4.44	3.58	3.78	4.33	4.80	4.37
1950	4.80	4.65	4.55	4.50	4.35	4.25	4.60	4.90	4.60	5.20	5.55	5.45	5.07
1951	5.80	6.20	6.10	6.10	6.00	5.70	5.50	4.85	4.00	4.65	4.85	4.85	4.55
1952	4.85	4.75	4.85	5.00	5.20	5.50	5.50	5.40	5.40	5.90	6.10	6.30	5.53
1953	6.50	6.70	7.00	7.00	7.00	6.70	5.80	5.00	4.80	5.50	5.50	6.30	5.01
1954	5.40	5.30	5.10	4.60	4.40	3.85	3.80	3.70	3.95	4.65	4.60	4.65	4.26
1955	4.50	4.45	4.65	4.30	4.40	4.35	4.00	4.00	4.50	4.70	4.50	4.50	4.66
1956	4.30	4.30	4.40	4.30	4.35	4.35	4.20	4.35	4.65	4.75	4.65	4.75	4.80
1957	5.05	5.05	5.05	4.95	5.10	5.20	5.30	5.05	5.15	5.35	5.30	5.10	5.28
1958	5.20	5.30	5.30	5.50	5.25	5.30	5.00	4.95	4.95	4.95	4.85	4.85	4.96
1959	5.10	5.00	5.00	5.10	4.95	5.10	4.95	4.50	4.55	4.65	4.65	4.80	4.65

Table 19. Cowpeas: Mid-month prices per bushel received by Louisiana farmers, 1915-1952

Year	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	Weighted avg.
						---------- dollars per bushel ----------							
1915		1.96	1.94	2.06	1.91	1.85	1.75	1.86	1.50	1.45	1.51	1.40	1.74
1916	1.62	1.28	1.55	1.64	1.54	1.38	1.20	1.40	1.43	1.35	1.70	1.85	1.50
1917	1.85	2.20	2.20	2.40	2.80	3.30	3.10	2.50	2.55	2.00	2.45	2.60	2.50
1918	2.70	2.90	3.10	2.95	2.80	2.60	2.75	2.95	2.15	2.50	2.50	2.75	2.72
1919	2.50	2.70	2.85	2.90	3.20	4.00	4.20	3.90	3.00	3.30	3.20	2.90	3.22
1920	3.70	3.60	3.70	4.40	5.20	5.30	3.70	4.60	3.60	3.43	2.61	2.62	3.87
1921	2.56	2.56	2.41	2.56	2.50	2.79	2.88	2.70	2.40	2.29	2.23	2.27	2.51
1922	2.14	2.20	2.41	2.52	2.45	2.06	2.13	2.11	2.07	2.26	2.28	2.40	2.25
1923	2.45	2.34	2.22	2.39	2.58	2.62	2.75	3.00	2.77	2.41	2.21	2.30	2.50
1924	2.40	2.50	2.75	3.00	3.10	3.20	3.00	3.00	3.30	3.10	2.50	3.00	3.75
1925	3.00	3.30	3.50	4.00	4.20	5.60	4.30	3.50	3.60	3.25	3.30	3.10	3.55
1926	2.80	2.88	3.66	3.95	3.70	3.90	3.40	3.90	2.80	3.00	3.10	2.75	2.70
1927	2.60	2.70	2.50	2.80	2.50	2.50	2.65	2.45	2.65	2.25	2.40	2.00	2.41
1928	2.30	2.40	2.35	2.45	2.55	2.55	2.65	2.45	2.35	2.25	2.15	2.50	2.69
1929	2.45	2.50	2.55	2.80	3.00	3.30	3.10	2.80	2.20	2.45	2.50	2.25	2.82
1930	2.55	2.70	2.90	3.00	3.10	3.20	3.30	2.90	2.75	2.45	2.60	2.25	2.42
1931	2.15	2.05	2.30	2.45	2.45	2.40	2.55	2.20	1.60	1.50	1.65	1.60	1.35
1932	1.60	1.35	1.45	1.32	1.10	1.15	.90	1.10	1.10	1.30	1.30	1.05	1.14
1933	1.00	1.00	1.05	1.05	1.15	1.25	1.35	1.50	1.30	1.20	1.15	1.10	1.61
1934	1.35	1.60	1.65	1.90	1.85	1.75	1.75	1.55	1.75	1.65	1.70	1.70	1.95
1935	1.70	1.85	2.00	2.15	2.05	2.10	1.85	1.70	1.45	1.45	1.45	1.35	1.76
1936	1.60	1.55	1.80	1.75	2.00	2.15	2.25	2.00	1.75	1.50	1.50	1.70	1.98
1937	1.90	1.95	2.00	2.10	2.25	2.25	2.05	1.95	1.70	1.50	1.50	1.60	1.64
1938	1.60	1.55	1.60	1.65	1.75	1.75	1.70	1.30	1.45	1.40	1.25	1.35	1.47
1939	1.30	1.45	1.50	1.55	1.60	1.65	1.50	1.50	1.40	1.25	1.00	1.25	1.35
1940	1.20	1.30	1.35	1.35	1.55	1.60	1.65	1.45	1.40	1.30	1.30	1.30	1.47
1941	1.35	1.45	1.50	1.50	1.50	1.55	1.55	1.55	1.45	1.50	1.50	1.60	2.03
1942	1.70	1.80	1.95	2.05	2.15	2.40	2.25	2.20	2.10	1.95	1.85	1.85	2.46
1943	2.05	2.30	2.45	2.50	2.75	2.85	2.60	2.70	2.60	2.60	2.60	2.55	3.28
1944	2.60	2.95	3.10	3.50	3.85	3.45	3.30	3.20	2.90	2.80	2.75	2.80	3.34
1945	2.85	3.05	3.20	3.50	3.60	3.40	3.50	3.40	3.00	2.90	3.00	3.00	3.45
1946	3.00	3.00	3.30	3.60	4.00	4.20	4.20	4.30	3.60	3.45	3.65	3.50	4.30
1947	3.75	3.50	4.10	4.60	4.60	4.80	4.40	3.65	3.45	3.45	3.25	3.25	4.77
1948	3.50	3.90	5.00	5.20	5.00	5.00	4.80	3.70	3.50	3.25	3.50	3.75	4.31
1949	4.00	4.10	4.25	4.50	4.50	4.40	4.20	3.40	3.30	3.50	3.10	3.40	3.54
1950	3.60	3.70	3.50	3.40	3.80	3.90	3.45	3.50	3.50	3.50	3.50	3.70	4.33
1951	3.60	4.10	4.65	4.40	4.40	4.40	4.30	4.00	3.65	4.00	3.90	4.00	4.67
1952	4.30	4.50	4.50	5.00	4.75	4.75	4.75	4.00	4.00	1/			4.50

1/ Discontinued.

Table 20. Corn: Mid-month prices per bushel received by Louisiana farmers, 1910-1959

Year	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	Weighte avg.
	---------- dollars per bushel ----------												
1910	.73	.74	.74	.77	.80	.82	.80	.74	.68	.63	.58	.58	.62
1911	.59	.60	.62	.66	.66	.66	.69	.70	.68	.68	.70	.70	.76
1912	.71	.72	.75	.81	.92	.92	.92	.88	.74	.68	.68	.70	.73
1913	.72	.72	.77	.79	.80	.82	.82	.84	.82	.82	.80	.77	.82
1914	.76	.77	.78	.79	.84	.89	.90	.86	.86	.84	.76	.82	.87
1915	.86	.86	.90	.94	.95	1.00	.98	.90	.84	.71	.64	.66	.72
1916	.68	.72	.78	.79	.77	.76	.78	.82	.83	.82	.88	.99	1.13
1917	1.01	1.02	1.12	1.30	1.48	1.61	1.78	1.84	1.70	1.54	1.48	1.50	1.62
1918	1.51	1.58	1.77	1.83	1.76	1.74	1.77	1.88	1.83	1.70	1.64	1.63	1.72
1919	1.65	1.67	1.62	1.68	1.80	1.80	1.84	1.84	1.74	1.67	1.57	1.58	1.73
1920	1.60	1.68	1.88	1.98	1.99	1.99	1.94	1.74	1.48	1.18	.92	.90	.99
1921	.96	1.00	.92	.88	.96	.98	.96	.88	.76	.66	.64	.68	.72
1922	.66	.70	.80	.80	.78	.82	.88	.85	.82	.81	.82	.85	.94
1923	.88	.93	1.10	1.10	1.10	1.13	1.12	1.06	1.03	1.04	1.05	1.05	1.09
1924	1.08	1.09	1.20	1.15	1.10	1.10	1.15	1.22	1.24	1.28	1.26	1.14	1.22
1925	1.16	1.25	1.30	1.20	1.40	1.32	1.24	1.10	1.10	1.00	1.02	.98	1.01
1926	1.15	1.00	1.00	1.06	1.02	1.00	1.04	.90	.95	.92	.89	.80	.90
1927	.85	.89	.84	.88	.91	.95	1.09	1.05	1.00	.90	.89	.94	.99
1928	.96	.98	1.02	1.02	1.07	1.16	1.18	1.10	1.10	.93	.95	.93	.98
1929	.91	.91	.99	1.08	1.01	1.03	1.06	1.02	.96	.92	.92	.92	.95
1930	.91	.95	.95	1.00	.99	.98	.94	.96	.99	.98	.91	.89	.89
1931	.89	.87	.89	.87	.83	.84	.82	.69	.56	.41	.42	.44	.44
1932	.44	.43	.45	.43	.43	.46	.46	.44	.41	.41	.38	.39	.44
1933	.36	.37	.39	.45	.55	.54	.66	.65	.57	.56	.57	.58	.63
1934	.59	.65	.67	.69	.71	.74	.75	.77	.81	.80	.83	.92	.91
1935	.91	.96	.98	1.02	1.00	.97	.95	.88	.76	.70	.67	.66	.71
1936	.65	.68	.72	.74	.74	.74	.81	.94	.99	.93	.89	.94	.96
1937	.96	.96	1.00	1.09	1.08	1.03	1.05	.93	.79	.67	.60	.60	.66
1938	.63	.63	.65	.69	.67	.67	.66	.62	.56	.50	.49	.49	.52
1939	.51	.51	.54	.58	.59	.64	.64	.59	.60	.60	.60	.61	.64
1940	.64	.67	.71	.71	.75	.74	.73	.73	.64	.61	.62	.60	.65
1941	.63	.66	.68	.74	.74	.74	.75	.75	.77	.75	.76	.76	.83
1942	.80	.85	.90	.96	.98	.96	.98	.95	.93	.90	.92	.95	.99
1943	.96	1.03	1.09	1.14	1.19	1.20	1.24	1.21	1.23	1.29	1.29	1.36	1.35
1944	1.37	1.40	1.45	1.42	1.41	1.45	1.44	1.38	1.40	1.38	1.36	1.38	1.39
1945	1.41	1.42	1.42	1.45	1.42	1.37	1.37	1.40	1.35	1.30	1.30	1.34	1.39
1946	1.30	1.36	1.43	1.43	1.55	1.65	1.97	1.89	1.72	1.75	1.75	1.75	1.79
1947	1.75	1.79	1.84	1.84	1.87	1.90	1.95	2.11	2.24	2.15	2.16	2.19	2.20
1948	2.24	2.20	2.24	2.25	2.25	2.20	2.20	2.03	1.87	1.74	1.25	1.58	1.58
1949	1.60	1.49	1.50	1.55	1.55	1.48	1.40	1.34	1.31	1.45	1.25	1.30	1.30
1950	1.30	1.30	1.31	1.35	1.35	1.35	1.44	1.44	1.44	1.36	1.36	1.39	1.46
1951	1.45	1.55	1.50	1.55	1.62	1.62	1.60	1.45	1.45	1.50	1.50	1.65	1.65
1952	1.77	1.77	1.77	1.85	1.81	1.80	1.75	1.75	1.75	1.79	1.80	1.80	1.79
1953	1.80	1.83	1.85	1.80	1.80	1.70	1.70	1.70	1.57	1.49	1.52	1.80	1.56
1954	1.57	1.62	1.65	1.65	1.68	1.65	1.55	1.51	1.45	1.45	1.44	1.40	1.43
1955	1.42	1.45	1.45	1.41	1.44	1.16	1.40	1.35	1.15	1.06	1.02	1.01	1.06
1956	1.01	1.04	1.08	1.09	1.16	1.18	1.18	1.15	1.15	1.15	1.17	1.22	1.24
1957	1.31	1.31	1.34	1.33	1.34	1.31	1.33	1.29	1.29	1.23	1.30	1.28	1.30
1958	1.28	1.31	1.35	1.35	1.36	1.32	1.35	1.34	1.23	1.19	1.13	1.14	1.20
1959	1.17	1.19	1.25	1.27	1.27	1.30	1.29	1.21	1.17	1.13	1.12	1.15	1.17

Table 21. Oats: Mid-month prices per bushel received by Louisiana farmers, 1910-1959

Year	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	Weighted avg.
						cents per bushel							
1910	60	60	63	60	58	59	59	54	52	50	50	50	56
1911	52	55	56	54	60	60	60	62	61	63	65	60	62
1912	61	64	64	68	67	65	62	58	54	52	52	52	59
1913	54	54	54	54	54	55	56	56	56	56	56	56	56
1914	58	61	60	58	58	56	58	60	64	66	64	66	62
1915	68	68	70	74	74	72	70	62	54	56	56	56	64
1916	56	58	60	60	60	58	57	58	55	56	63	68	61
1917	71	72	74	77	80	82	86	96	91	89	96	92	90
1918	84	87	101	110	110	106	108	112	108	103	101	97	105
1919	96	94	92	98	100	104	106	102	93	89	97	96	105
1920	104	120	120	116	118	119	124	117	102	106	96	78	109
1921	88	91	76	71	62	55	59	62	70	74	70	68	62
1922	62	64	65	62	56	54	58	62	64	62	64	64	61
1923	65	66	66	73	72	70	66	63	64	67	69	63	66
1924	66	66	65	61	65	65	67	60	68	70	78	81	70
1925	84	85	85	70	68	75	76	61	64	70	75	80	69
1926	65	59	63	61	60	56	60	60	61	64	70	65	61
1927	60	65	65	60	60	63	60	62	65	62	68	65	64
1928	64	67	71	77	80	81	77	69	62	64	67	65	72
1929	63	68	67	64	65	70	68	69	70	71	68	67	68
1930	69	68	65	64	65	64	56	58	57	55	54	56	57
1931	54	52	56	47	51	45	39	33	36	31	33	34	37
1932	32	32	33	32	33	31	31	30	30	27	26	28	30
1933	28	28	30	32	34	37	48	47	46	42	45	42	45
1934	44	45	50	48	48	51	48	58	58	68	73	65	62
1935	65	64	63	65	64	59	56	54	50	46	46	44	49
1936	42	46	45	40	45	35	43	51	54	50	56	57	54
1937	60	60	64	64	66	54	58	51	49	49	47	45	51
1938	43	42	42	42	41	38	38	34	37	37	38	37	37
1939	40	40	41	40	38	39	36	35	46	45	45	45	40
1940	46	50	50	50	50	43	40	40	40	42	43	43	42
1941	43	43	43	45	44	40	41	41	45	52	54	56	47
1942	56	57	60	60	60	55	55	55	56	60	60	65	58
1943	66	71	76	78	80	76	81	85	92	101	100	102	88
1944	102	103	102	99	97	98	98	97	98	96	99	98	98
1945	97	98	97	98	97	80	84	84	85	86	87	92	85
1946	92	92	92	98	103	113	124	121	116	110	115	113	116
1947	107	112	115	115	115	109	108	106	115	129	135	130	114
1948	133	115	121	128	124	108	107	101	108	102	96	104	106
1949	108	102	98	102	97	88	83	90	96	96	94	96	90
1950	94	99	96	94	99	92	103	99	103	97	102	102	99
1951	102	110	115	110	105	100	105	105	110	110	120	125	108
1952	125	125	120	115	111	100	100	105	115	117	120	110	105
1953	115	110	105	95	100	82	81	85	89	97	102	110	88
1954	101	97	99	95	91	75	75	80	90	96	97	92	84
1955	95	95	93	90	90	75	71	76	76	80	78	77	76
1956	77	77	79	77	75	66	69	73	78	80	87	89	73
1957	87	87	87	87	80	65	72	80	85	87	85	85	74
1958	85	80	85	81	80	75	80	80	90	90	85	85	80
1959	85	90	85	85	80	75	73	78	78	80	84	82	77

Table 22. Hay: Mid-month prices per ton received by Louisiana farmers, 1910-1959

Year	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	Weighted avg.
						---------- dollars per ton ----------							
1910	10.50	11.50	12.05	11.75	11.05	11.20	11.15	11.60	11.50	10.30	10.85	10.75	11.20
1911	10.90	11.80	11.80	11.45	10.85	11.15	12.05	12.20	11.25	10.90	11.65	12.20	12.70
1912	12.90	14.00	15.05	15.25	14.50	13.50	12.70	12.20	12.15	11.40	11.60	13.35	12.50
1913	13.35	12.70	12.50	12.15	11.75	11.50	11.55	12.10	12.00	12.15	12.70	12.25	12.50
1914	12.45	13.25	13.50	13.00	12.50	12.25	12.25	12.45	12.55	12.40	12.10	11.55	12.20
1915	10.90	11.30	11.95	12.75	13.30	13.45	13.40	12.65	11.70	11.60	11.20	11.25	12.00
1916	11.50	10.70	11.60	12.30	12.20	11.45	11.00	11.00	11.00	11.50	11.25	11.30	11.90
1917	12.00	12.65	12.55	13.30	15.70	16.00	15.15	14.40	13.60	15.00	15.30	14.90	16.80
1918	17.75	19.98	19.98	20.75	21.30	20.15	18.15	17.85	18.55	19.25	20.60	21.10	21.00
1919	21.50	22.40	23.90	25.50	25.45	23.45	22.50	22.50	19.85	19.35	22.00	22.50	22.60
1920	23.75	23.75	23.00	24.15	24.65	23.00	22.35	20.90	18.30	17.10	15.85	16.20	18.20
1921	17.25	17.90	17.40	15.95	14.85	14.75	14.45	13.95	13.75	13.00	13.05	13.30	13.20
1922	12.15	12.35	12.50	12.50	13.00	13.90	13.60	13.00	12.95	12.40	12.90	14.15	13.80
1923	14.15	14.00	14.85	14.90	15.45	15.55	15.25	14.25	13.25	14.00	14.75	15.00	14.60
1924	15.00	15.00	15.00	14.50	15.00	15.00	15.00	18.00	17.00	18.00	16.30	19.00	18.00
1925	20.00	20.50	22.00	18.00	17.40	17.70	18.00	14.00	15.00	15.60	13.90	18.00	17.60
1926	19.40	20.90	18.90	19.90	21.00	19.00	18.00	20.00	17.00	15.00	14.90	14.80	15.70
1927	13.50	14.40	13.00	14.00	14.00	13.00	13.50	13.00	11.00	13.00	12.50	13.50	13.60
1928	15.00	15.50	14.50	14.30	13.90	14.10	14.00	13.00	13.10	12.20	12.20	13.10	13.20
1929	12.80	13.30	14.30	13.50	13.50	12.50	13.00	12.00	12.50	12.40	12.40	13.20	12.80
1930	12.70	13.40	13.90	13.00	12.00	13.00	12.00	12.00	12.90	13.00	12.00	11.60	12.00
1931	11.60	12.50	12.50	11.50	10.90	11.00	9.50	9.20	8.40	8.60	7.80	8.00	8.60
1932	8.20	8.10	8.80	7.40	7.40	7.00	7.00	7.00	7.50	7.50	8.10	7.70	7.30
1933	6.70	7.10	7.20	6.80	7.50	7.50	6.90	8.30	8.00	7.60	7.20	7.50	7.70
1934	8.30	7.40	8.20	7.50	7.00	8.00	8.10	8.10	9.50	9.30	9.00	9.70	9.60
1935	10.00	11.00	12.00	10.60	10.10	9.30	9.20	8.80	8.50	8.00	9.50	8.80	9.40
1936	9.40	8.90	10.70	9.30	10.60	8.80	9.20	10.70	11.40	10.50	9.50	10.30	10.30
1937	11.10	11.00	10.50	10.30	10.60	10.50	10.10	9.30	9.80	9.70	10.20	9.70	10.00
1938	10.00	10.80	10.10	10.00	10.30	9.50	9.90	9.00	9.00	9.30	8.60	9.50	9.20
1939	9.00	9.00	10.00	10.00	9.00	8.30	8.90	8.00	8.70	8.10	8.90	8.90	11.40
1940	9.60	10.70	10.70	10.00	10.40	9.50	9.30	7.70	7.80	8.40	8.40	9.00	10.80
1941	8.60	8.90	9.30	9.50	10.00	10.00	9.00	8.20	9.00	9.20	9.00	9.30	11.20
1942	9.60	10.40	11.00	11.30	10.80	10.60	10.00	9.40	10.20	10.50	10.70	11.60	13.10
1943	12.20	13.70	14.20	14.40	12.80	12.50	14.00	14.50	14.20	14.50	16.00	16.20	22.20
1944	17.60	18.50	18.40	18.30	16.00	15.40	15.00	16.00	16.50	15.30	16.60	16.70	21.70
1945	17.50	17.50	17.00	16.00	16.00	16.50	16.00	16.00	14.50	15.00	15.50	16.00	21.40
1946	16.00	16.50	16.00	16.00	15.50	15.00	16.10	16.10	17.10	16.80	18.00	18.00	23.40
1947	18.00	17.30	17.80	18.00	16.20	15.10	16.10	15.70	18.70	19.20	19.80	20.30	24.90
1948	20.60	21.00	24.00	21.70	20.20	20.10	24.30	26.00	21.80	25.50	26.60	27.60	26.40
1949	26.90	26.40	28.30	26.60	25.50	23.70	23.10	21.80	22.30	22.20	21.90	22.70	22.50
1950	23.80	21.80	21.00	22.10	26.10	21.20	20.30	20.50	21.50	22.80	25.40	26.50	24.40
1951	25.90	27.70	28.90	26.10	24.70	25.70	25.10	26.00	25.30	27.10	30.40	29.20	28.50
1952	32.00	31.20	30.50	28.10	28.10	26.40	26.30	28.60	29.10	30.40	31.30	31.30	29.80
1953	30.80	29.40	27.70	27.50	26.60	24.20	25.20	25.20	24.00	23.60	25.40	31.30	25.30
1954	27.60	24.90	25.50	25.70	24.40	23.00	21.80	23.30	23.80	23.60	24.60	25.20	24.40
1955	26.20	25.10	24.60	23.90	24.20	20.70	22.00	22.40	20.40	21.60	20.80	21.20	21.70
1956	21.80	22.80	21.80	19.50	20.70	20.50	18.80	18.70	21.30	23.00	23.20	24.00	22.80
1957	25.90	25.90	24.70	24.00	22.30	21.30	22.50	20.90	22.10	22.10	23.60	23.60	23.00
1958	23.60	24.80	25.70	24.20	23.10	21.70	21.80	21.10	22.10	20.50	20.60	22.20	21.50
1959	21.90	22.40	22.40	21.90	20.60	22.10	21.60	20.30	21.30	21.30	21.70	22.40	22.00

Table 23. Sweet Potatoes: Mid-month prices per hundred pounds received by Louisiana farmers, 1910-1959

Year	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	Weighted avg.
			---------- dollars per hundred pounds ----------										
1910	1.09	1.09	1.16	1.24	1.15	1.07	1.20	1.42	1.47	1.29	1.05	1.00	1.25
1911	1.13	1.18	1.27	1.44	1.49	1.38	1.64	1.44	1.44	1.31	1.09	1.04	1.31
1912	1.18	1.24	1.45	1.67	1.51	1.44	1.55	1.53	1.55	1.31	1.20	1.07	1.36
1913	1.27	1.36	1.44	1.56	1.63	1.45	1.27	1.45	1.36	1.27	1.18	1.09	1.29
1914	1.27	1.18	1.36	1.44	1.45	1.45	1.60	1.55	1.29	1.27	1.05	.95	1.22
1915	1.00	1.13	1.25	1.35	1.55	1.45	1.44	1.38	1.18	1.00	.78	.87	1.05
1916	1.02	1.04	1.15	1.18	1.18	1.18	1.45	1.44	1.29	1.15	1.09	1.09	1.33
1917	1.18	1.27	1.73	1.73	1.82	1.82	1.82	1.82	2.09	1.82	1.73	1.82	2.04
1918	1.82	2.18	2.73	2.69	2.27	1.82	2.09	2.55	2.45	2.73	2.55	2.13	2.67
1919	2.36	2.91	3.00	3.64	3.09	3.09	3.27	3.82	4.00	2.36	2.18	2.00	2.94
1920	2.73	2.91	2.91	3.27	3.45	4.55	3.64	3.64	3.44	2.24	1.62	1.64	2.11
1921	1.80	1.64	1.64	2.38	2.04	2.11	2.80	1.98	1.55	1.49	1.25	1.18	1.53
1922	1.27	1.33	1.55	1.75	1.64	1.87	2.20	1.93	1.60	1.53	1.05	.93	1.62
1923	1.51	1.69	1.93	1.93	1.98	1.89	1.69	1.96	2.95	2.15	1.89	1.82	2.25
1924	2.00	2.73	2.36	2.27	2.91	2.73	2.36	3.09	3.18	2.84	3.00	3.15	3.11
1925	2.73	3.45	4.47	6.18	5.60	3.64	3.33	3.20	3.78	3.78	2.44	1.80	2.94
1926	2.65	2.38	2.64	2.73	3.27	2.73	2.00	2.91	2.55	2.18	1.27	1.45	1.93
1927	1.64	2.00	2.00	2.00	2.00	2.36	2.09	2.18	2.27	1.64	1.45	1.73	1.80
1928	1.55	1.55	1.73	1.91	1.91	1.91	1.73	1.73	1.82	1.55	1.55	1.55	1.84
1929	1.55	1.91	2.00	1.91	2.18	2.64	2.64	2.55	2.27	2.00	1.73	1.82	2.11
1930	1.82	1.82	1.91	2.18	2.55	2.55	2.36	2.45	2.27	2.09	1.73	1.73	2.02
1931	1.64	1.64	1.73	2.00	2.00	1.55	1.45	1.73	1.36	1.18	1.00	.82	1.09
1932	1.00	1.00	1.00	.91	.91	.91	.91	1.00	.84	.82	.73	.73	.84
1933	.73	.75	.78	.84	1.18	1.18	1.18	1.64	1.27	1.09	.91	1.09	1.18
1934	1.18	1.18	1.18	1.18	1.27	1.55	1.27	1.45	1.55	1.27	1.18	1.18	1.34
1935	1.18	1.27	1.45	1.45	1.55	1.45	1.55	1.36	1.09	1.00	.91	.91	1.05
1936	1.00	1.00	1.00	1.09	1.27	1.36	1.64	2.27	1.45	1.64	1.36	1.36	1.58
1937	1.45	1.55	1.73	2.00	2.00	1.82	1.55	1.45	1.45	1.18	1.09	1.18	1.25
1938	1.18	1.27	1.36	1.27	1.45	1.55	1.36	1.55	1.09	1.00	.91	1.00	1.16
1939	1.00	1.18	1.18	1.27	1.45	1.45	1.55	1.45	1.09	1.00	.91	1.00	1.14
1940	1.00	1.27	1.36	1.36	1.36	1.55	1.55	1.64	1.55	1.36	1.18	1.27	1.38
1941	1.27	1.45	1.45	1.55	1.55	1.64	1.73	1.64	1.45	1.27	1.09	1.18	1.31
1942	1.27	1.36	1.36	1.36	1.36	1.45	1.64	2.45	1.91	1.82	1.55	1.82	1.82
1943	2.00	2.09	2.91	3.00	3.27	3.27	8.18	4.00	3.55	3.27	2.91	2.73	3.29
1944	2.82	3.00	3.27	3.45	3.82	4.00	3.55	3.45	2.27	2.45	2.27	2.45	2.64
1945	2.82	3.09	3.18	3.18	3.64	3.64	4.09	4.09	1.73	2.00	2.45	2.91	2.65
1946	2.91	3.45	3.82	4.00	4.27	4.45	4.45	3.64	2.18	2.55	2.73	3.18	2.85
1947	3.18	3.45	3.09	3.09	2.91	4.00	3.27	4.09	2.73	2.18	2.45	3.00	2.76
1948	3.00	4.00	3.35	3.45	3.45	3.20	4.10	2.75	3.90	2.35	2.45	2.75	2.91
1949	4.55	4.55	4.20	4.90	3.30	3.85	5.45	3.90	3.35	2.90	2.75	3.00	3.07
1950	3.10	2.90	2.75	3.00	2.45	1.45	1.80	1.80	1.65	1.25	1.45	2.25	1.78
1951	2.55	2.55	2.55	2.55	2.75	2.75	2.75	5.20	5.00	4.45	4.10	5.45	5.16
1952	6.55	6.55	7.20	8.20	8.20	8.45	11.25	5.65	4.55	4.10	4.90	6.55	5.07
1953	6.90	4.60	7.65	8.00	7.65	6.70	7.45	4.00	2.75	3.20	3.55	6.55	3.44
1954	3.45	3.64	3.18	4.00	3.18	3.20	4.55	1.65	2.30	2.45	3.35	4.45	3.25
1955	2.75	2.75	2.80	2.80	2.70	-	-	2.18	1.91	1.45	1.82	2.18	1.81
1956	1.91	1.73	1.73	1.45	1.55	-	-	2.00	2.45	2.10	2.25	2.40	2.58
1957	3.40	3.40	3.40	3.00	-	-	4.85	2.75	2.40	2.20	1.95	4.85	3.27
1958	5.00	5.30	5.05	5.55	-	-	5.50	3.50	2.10	1.65	2.10	2.80	2.70
1959	2.90	2.45	2.10	2.25	2.10	-	-	1.95	1.55	1.35	1.25	2.10	1.60

Table 24. Irish Potatoes: Mid-month prices per hundred pounds received by Louisiana farmers, 1910-1959

Year	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	Weighted avg.
					---------- dollars per hundred pounds ----------								
1910	1.68	1.83	1.80	1.58	1.37	1.17	1.10	1.23	1.32	1.38	1.48	1.42	1.30
1911	1.47	1.58	1.60	1.47	1.33	1.33	1.40	1.68	1.83	1.87	1.77	1.67	1.42
1912	1.73	1.77	1.83	2.08	2.08	1.75	1.50	1.47	1.48	1.33	1.32	1.43	1.83
1913	1.57	1.68	1.83	1.87	1.80	1.53	1.27	1.30	1.43	1.67	1.72	1.60	1.63
1914	1.63	1.80	1.87	1.73	1.67	1.55	1.43	1.58	1.67	1.73	1.73	1.73	1.62
1915	1.83	1.87	1.90	1.85	1.85	1.77	1.53	1.50	1.50	1.57	1.65	1.47	1.75
1916	1.45	1.87	2.33	2.28	1.90	1.70	1.57	1.67	2.08	2.62	2.85	2.90	1.90
1917	3.08	3.85	4.67	4.87	4.60	4.37	4.02	3.83	3.67	3.22	3.12	3.08	4.32
1918	3.17	3.60	3.73	3.30	2.23	1.43	1.60	2.03	2.38	2.55	2.63	2.75	1.70
1919	3.13	3.07	2.93	3.17	3.33	3.00	2.70	2.65	2.53	3.03	3.63	3.80	3.02
1920	4.33	5.27	5.47	6.00	5.17	5.75	4.42	4.67	4.03	3.63	3.45	3.33	3.65
1921	3.17	3.23	3.37	2.75	2.58	2.50	2.33	2.65	2.87	3.07	3.13	3.07	2.72
1922	3.23	3.83	4.18	3.08	2.60	2.18	2.33	2.33	2.37	2.80	2.92	2.50	2.25
1923	2.53	2.95	3.58	3.38	2.67	2.42	2.42	2.25	2.47	2.70	2.67	2.58	2.45
1924	3.07	2.50	2.08	2.33	2.25	2.42	1.92	2.00	2.75	2.67	2.67	2.33	2.10
1925	2.48	2.50	2.50	2.42	2.22	2.83	2.92	3.50	3.60	3.22	4.88	4.60	2.22
1926	3.97	4.67	4.67	4.67	4.25	2.38	2.20	2.83	2.50	2.50	2.67	3.00	3.33
1927	3.17	3.17	3.17	4.25	2.17	2.58	3.25	2.83	2.83	2.58	2.58	2.58	2.82
1928	2.50	2.50	2.67	2.67	1.95	1.16	1.50	1.42	1.42	1.83	1.92	1.92	1.67
1929	2.08	2.25	2.17	2.75	2.67	2.17	2.42	2.50	2.83	2.83	2.75	2.67	2.50
1930	2.58	2.67	2.67	3.75	2.30	2.17	2.17	2.25	2.75	2.42	2.17	2.17	2.25
1931	2.17	2.08	2.08	1.83	1.33	.83	.83	.83	1.00	1.00	1.42	1.50	.83
1932	1.48	1.33	1.58	2.00	1.75	.92	.92	.92	1.08	1.33	1.00	1.17	1.15
1933	1.00	1.08	1.33	1.67	1.23	1.25	1.33	2.00	2.33	1.75	1.75	1.50	1.22
1934	1.92	1.92	2.17	1.50	1.22	.63	1.00	1.25	1.25	1.25	1.50	1.67	.85
1935	1.75	1.58	1.58	2.33	1.00	1.00	1.25	1.08	1.25	1.33	1.42	1.42	1.17
1936	1.50	1.33	1.58	2.08	1.92	2.42	2.00	2.17	2.17	2.17	2.33	2.25	2.08
1937	2.25	2.67	1.83	1.16	.75	.83	1.00	1.25	1.33	1.33	1.42	1.42	1.08
1938	1.42	1.58	1.50	1.00	1.00	.92	1.00	1.17	1.33	1.25	1.33	1.58	1.00
1939	1.58	1.42	1.75	1.83	1.08	1.00	1.08	1.33	1.83	1.58	1.50	1.58	1.25
1940	1.67	1.83	1.83	1.92	1.35	1.30	1.33	1.42	1.33	1.42	1.58	1.42	1.35
1941	1.33	1.42	1.42	1.83	1.02	.92	1.00	1.17	1.42	1.58	1.67	1.83	1.02
1942	2.08	2.33	2.33	2.67	2.00	1.33	1.58	2.08	2.00	2.17	2.17	2.25	1.85
1943	2.25	2.42	2.75	3.92	2.53	2.67	2.68	2.83	3.00	3.08	3.08	3.25	2.62
1944	3.25	3.25	3.42	2.25	2.08	1.83	1.83	2.42	2.75	3.00	2.83	2.83	2.03
1945	2.92	3.17	3.58	3.25	3.17	3.07	3.50	3.83	3.50	3.33	3.08	3.00	3.22
1946	3.33	3.33	3.58	3.25	2.17	1.92	2.83	3.17	3.17	3.33	3.33	3.17	2.28
1947	2.90	3.10	3.35	3.35	2.75	2.50	2.50	2.75	2.90	3.10	3.10	3.60	2.67
1948	3.75	3.75	3.75	3.75	3.10	2.85	3.00	3.00	3.15	3.25	3.30	3.00	3.18
1949	3.15	3.15	3.35	3.35	3.10	3.10	3.60	3.15	3.35	3.00	3.15	3.15	3.20
1950	3.30	3.30	3.15	2.40	2.50	2.50	2.90	3.35	3.55	3.30	3.15	3.35	2.57
1951	3.40	3.15	3.40	3.75	2.85	2.25	2.90	3.35	3.35	3.40	4.60	3.10	2.74
1952	4.30	4.30	4.30	4.60	4.40	4.45	4.60	4.60	4.60	4.60	4.60	4.35	4.49
1953	4.60	6.75	4.60	1.85	1.85	1.40	2.10	2.10	2.30	2.65	1/	4.60	1.85
1954	-	-	-	2.65	2.30	1.90	2.50	3.35	4.00	-	-	-	2.22
1955	-	-	-	-	2.90	3.33	2.92	-	-	-	-	-	4.42
1956	-	-	-	4.80	3.90	3.90	-	5.00	-	-	-	-	3.98
1957	-	-	-	-	2.00	2.00	1.80	-	-	-	-	-	2.02
1958	-	-	-	-	2.80	2.15	2.20	-	-	-	-	-	2.49
1959	-	-	-	-	2.80	3.40	-	-	-	-	-	-	2.89

1/ Not quoted.

Table 25. Dollars per unit of farm products received by farmers for products not marketed throughout the year, Louisiana, 1910-1959

Year	Sugar cane	Sirup	Oranges	Pears	Peaches	Straw-berries	Pecans
	ton	gal.	box	bu.	bu.	lb.	lb.
1910	3.69	.44	-	-	1.00	-	-
1911	4.29	.44	-	-	1.00	-	-
1912	3.73	.41	-	-	.80	-	-
1913	3.13	.43	-	-	1.50	-	-
1914	3.75	.43	-	-	1.00	-	-
1915	4.55	.48	-	-	.95	-	-
1916	5.29	.55	-	-	.85	-	-
1917	7.10	.59	-	-	1.25	-	-
1918	7.28	.68	-	-	1.40	15.97	-
1919	14.00	1.07	2.79	1.25	1.80	17.36	29.0
1920	5.76	.96	1.74	1.75	2.70	18.61	31.0
1921	3.63	.54	2.39	2.29	1.45	18.06	21.0
1922	5.83	.49	2.29	1.71	1.45	11.94	21.7
1923	7.09	.59	.84	1.70	1.90	16.67	18.7
1924	5.58	.43	1.72	1.90	1.85	18.06	26.3
1925	4.05	.35	2.23	1.45	1.75	16.67	19.8
1926	4.92	.41	2.11	1.30	1.50	18.56	17.3
1927	4.61	.44	3.51	1.40	1.80	14.50	20.3
1928	3.86	.37	2.50	1.35	1.60	16.72	13.9
1929	3.77	.41	2.86	1.35	1.70	12.28	18.2
1930	3.38	.36	1.53	1.30	1.75	14.22	14.4
1931	3.29	.39	1.33	.90	1.05	11.44	9.4
1932	3.06	.34	1.28	.70	1.05	6.72	8.3
1933	3.29	.33	1.44	1.00	1.10	7.25	7.0
1934	2.33	.37	1.06	.55	.75	7.69	12.4
1935	3.18	.40	1.62	.75	1.05	9.36	8.7
1936	3.71	.36	1.62	.65	1.10	9.67	12.2
1937	2.91	.41	1.37	.70	1.25	8.50	8.2
1938	2.66	.38	1.00	.50	1.00	9.72	9.5
1939	2.88	.35	1.10	.70	1.05	9.03	9.6
1940	2.72	.40	1.00	.50	1.00	10.06	9.7
1941	3.94	.56	1.20	.60	1.05	7.92	10.0
1942	4.35	.62	2.25	.65	1.30	11.39	15.4
1943	4.60	.74	3.40	1.70	3.10	20.30	20.2
1944	4.98	.66	2.60	1.25	3.00	27.33	18.6
1945	5.58	.74	2.55	1.30	2.95	28.19	21.1
1946	6.55	1.20	1.90	1.50	3.05	28.87	30.7
1947	7.24	.80	1.75	1.45	2.85	25.06	24.6
1948	5.88	.80	1.85	1.25	2.90	28.70	12.3
1949	6.20	.70	2.20	1.30	2.80	29.47	17.1
1950	7.88	.80	2.15	1.30	3.40	26.64	26.4
1951	5.87	.85	3.80	1.55	3.40	24.30	19.3
1952	6.64	.94	3.50	1.50	3.30	30.19	20.0
1953	7.10	.93	3.45	1.45	3.10	27.58	15.7
1954	6.71	.87	2.85	1.35	3.65	20.78	25.9
1955	6.26	.87	2.55	1.45	-	31.44	29.5
1956	7.87	.83	3.85	1.35	3.30	28.50	18.2
1957	6.69	.86	3.30	1.50	3.35	32.70	22.3
1958	7.30	.80	3.85	1.30	2.40	29.00	27.4
1959	6.80	.86	3.85 1/	1.30	2.50	26.90	32.4

1/ 1958 average price.

(Continued)

Table 25. Dollars per unit of farm products received by farmers for products not marketed throughout the year, Louisiana, 1915-1959 (Continued)

Year	Cowpeas	Cabbage	Spring beans	Fall beans	Water-melons	Green peppers	Tomatoes	Truck crops for processing
	bu.	cwt.	cwt.	cwt.	cwt.	cwt.	cwt.	ton
1915	1.74	-	-	-	-	-	-	-
1916	1.50	-	-	-	-	-	-	-
1917	2.50	-	-	-	-	-	-	-
1918	2.72	2.75	7.50	-	-	-	-	-
1919	3.22	2.62	7.85	-	-	-	-	-
1920	3.87	2.01	7.50	-	-	-	-	-
1921	2.51	1.12	9.15	-	-	-	-	-
1922	2.25	1.00	5.35	5.85	-	-	-	-
1923	2.50	2.14	8.50	6.15	-	-	-	-
1924	3.75	2.44	6.00	6.15	-	5.20	-	-
1925	3.55	1.12	4.50	6.15	-	4.80	5.66	-
1926	2.70	1.76	7.15	5.50	-	5.60	3.40	-
1927	2.41	1.09	4.50	4.35	-	4.80	1.89	-
1928	2.69	1.16	5.15	5.15	-	3.60	2.36	61.40
1929	2.82	1.10	4.50	3.65	-	3.72	2.36	46.00
1930	2.42	1.79	3.50	3.45	-	2.80	2.08	32.40
1931	1.35	.83	2.70	3.15	-	2.60	2.36	32.20
1932	1.14	1.32	1.85	2.00	-	3.40	2.74	22.80
1933	1.61	1.08	2.75	2.25	-	2.40	1.70	18.80
1934	1.95	.53	2.40	2.65	.283	1.92	1.32	21.55
1935	1.76	1.15	2.35	3.35	.300	1.96	1.42	16.60
1936	1.98	.92	4.00	3.00	.333	1.92	1.89	21.10
1937	1.64	1.15	3.85	4.50	.320	2.40	2.36	21.70
1938	1.47	.73	2.35	2.65	.377	2.00	1.13	22.40
1939	1.35	1.02	3.00	3.15	.477	4.40	2.17	26.40
1940	1.47	1.20	3.85	2.15	.520	3.20	1.51	23.90
1941	2.03	1.10	4.15	5.50	.563	2.40	2.17	26.85
1942	2.46	.82	4.65	6.35	.750	4.60	3.40	37.55
1943	3.28	3.38	7.65	8.00	1.450	13.00	6.60	65.40
1944	3.34	1.40	7.50	8.15	1.667	7.60	6.13	59.50
1945	3.45	1.30	8.35	9.15	1.733	8.80	6.32	56.15
1946	4.30	2.00	7.00	8.00	1.400	8.80	6.60	70.35
1947	4.77	.99	7.65	8.00	1.187	11.00	4.81	76.39
1948	4.31	2.26	9.15	7.65	1.500	8.00	6.60	68.30
1949	3.54	1.45	9.15	5.00	1.357	10.40	4.81	65.00
1950	4.33	.77	8.15	7.35	1.583	6.00	10.75	40.20
1951	4.67	3.08	8.35	9.85	1.567	3.80	6.98	63.50
1952	4.50	2.90	9.00	10.65	1.417	17.80	10.38	68.13
1953	4.45	.84	8.35	6.50	1.620	17.40	15.09	85.00
1954	4.40	1.26	5.50	8.15	1.427	4.60	6.32	68.20
1955	3.75	1.65	6.65	6.00	1.100	6.00	7.80	36.30
1956	4.20	1.25	9.10	6.10	1.400	13.20	14.70	34.55
1957	4.40	1.95	8.40	8.30	1.500	10.20	11.90	39.40
1958	4.70	1.90	6.50	6.80	1.300	6.40	9.10	39.50
1959	4.00	1.55	6.90	8.00	1.200	8.80	10.40	32.95

Table 26. All farm products: Index numbers of prices received by Louisiana farmers, by months, 1910-1959

(Crop year 1935-39=100)

Year	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	Weighted avg.
						per cent							
1910	117	113	113	115	115	113	113	114	110	111	112	114	118
1911	116	114	113	111	112	111	112	110	102	98	96	95	108
1912	93	97	99	104	108	104	111	107	105	100	103	107	115
1913	107	103	105	103	105	104	105	107	108	111	112	103	113
1914	107	104	103	106	109	109	112	114	102	91	86	92	100
1915	96	101	100	103	103	101	101	98	102	109	113	112	118
1916	117	120	120	123	118	122	122	130	132	140	153	153	156
1917	156	156	161	175	189	196	212	206	206	212	222	230	246
1918	233	239	247	240	236	231	230	234	241	236	229	226	249
1919	254	253	250	249	266	280	292	306	288	392	299	305	345
1920	283	280	285	287	280	285	273	249	216	187	167	149	175
1921	129	124	118	112	113	111	110	115	132	144	137	131	143
1922	141	137	141	139	144	156	158	156	151	154	169	171	177
1923	182	188	196	196	185	183	184	179	190	196	201	212	216
1924	206	204	189	194	196	191	190	190	174	174	172	177	173
1925	170	171	176	177	174	175	176	171	170	168	159	156	162
1926	162	156	154	152	152	153	150	146	150	130	127	126	140
1927	123	130	130	132	133	137	139	144	166	158	155	152	154
1928	142	141	144	146	154	152	154	150	145	148	146	147	147
1929	146	145	148	147	144	144	144	144	146	144	140	141	146
1930	138	135	129	133	131	128	119	113	108	104	103	100	115
1931	98	98	99	99	96	89	93	80	75	71	77	75	83
1932	71	70	72	68	65	61	63	68	73	70	67	65	74
1933	65	63	66	68	77	79	87	84	85	86	88	87	90
1934	85	91	93	91	89	91	83	99	104	102	103	102	98
1935	107	107	107	107	109	107	107	102	97	100	103	104	102
1936	107	106	106	108	109	109	113	116	117	115	114	116	116
1937	113	114	116	119	114	110	110	101	92	91	89	87	96
1938	85	86	86	85	87	84	86	86	85	86	87	87	90
1939	88	88	88	87	88	88	88	85	95	91	92	94	95
1940	95	92	93	89	95	93	95	93	91	93	95	95	101
1941	104	106	108	115	118	122	130	133	133	141	144	141	146
1942	161	164	168	174	172	167	168	166	167	166	168	171	172
1943	185	186	191	195	194	194	200	192	192	192	191	188	200
1944	193	195	197	197	195	193	194	192	192	197	198	198	196
1945	203	203	203	204	207	208	210	208	204	209	211	213	208
1946	222	222	228	231	235	239	260	268	273	294	280	283	268
1947	312	310	316	313	307	308	322	324	305	307	319	336	291
1948	351	346	321	347	345	341	352	336	285	302	311	316	274
1949	317	299	293	296	281	289	288	284	274	262	270	274	261
1950	305	274	275	277	304	280	294	317	333	331	343	354	305
1951	357	375	375	378	353	363	348	312	323	333	330	356	305
1952	390	354	350	359	355	362	367	349	342	335	331	339	311
1953	337	327	369	334	333	319	314	290	282	293	293	335	273
1954	287	287	282	277	273	262	265	256	266	272	267	269	260
1955	264	269	270	265	267	261	264	262	262	258	254	258	253
1956	250	252	253	251	255	259	254	254	260	251	256	258	259
1957	282	269	267	268	274	274	285	274	278	272	271	261	262
1958	275	280	288	296	286	271	288	288	289	273	274	279	274
1959 1/	280	278	278	285	285	290	288	270	272	270	266	270	276

1/ Simple average of the 12 monthly prices

Table 27. Index numbers of prices received per unit of farm products by groups and Index of prices paid by farmers, Louisiana, 1910-1959

(Crop year 1935-39=100)

Year	Livestock & products	Meat animals	Poultry & eggs	Dairy products	Wool	Crops	Cotton lint	Sugar cane	Food grains	Feed & hay	Oil bearing crops	Sweetpotatoes	Irish potatoes	Vegetables	Fruits	Pecans	Tung nuts	All farm products	Index of prices paid by farmers
1910		99	95	100	91		133	121	93	98	92	101	99	91	93			118	77
1911		86	87	101	68		119	138	89	93	75	106	108	101	93			108	78
1912		90	90	101	68		102	121	121	109	64	110	139	106	74			115	81
1913		100	96	100	62		114	104	118	107	69	104	124	104	139			113	81
1914		113	95	101	64		98	122	109	111	62	99	123	104	93			100	82
1915		106	88	105	66		84	147	122	114	80	85	133	98	88			118	84
1916		117	105	104	83		128	171	115	107	140	107	144	109	79			156	93
1917		164	125	123	144		206	225	195	180	196	165	328	179	116			246	118
1918		190	152	150	192		279	233	254	218	227	216	129	187	172			249	138
1919		195	179	178	166		284	441	289	222	218	238	229	225	204			345	157
1920		188	199	193	103		302	196	272	210	186	171	277	253	215			175	171
1921		123	137	156	49		116	122	111	120	75	124	206	170	198			143	124
1922		104	126	135	64		177	185	127	110	104	131	171	147	147			177	121
1923		108	141	139	103		252	225	137	138	121	182	184	176	176			216	127
1924	120	107	140	136	122	194	223	173	179	173	135	251	159	223	202	274		173	128
1925	126	118	151	126	170	178	195	127	202	154	135	238	168	206	184	206		162	131
1926	131	124	150	132	117	143	126	153	151	137	96	156	253	184	190	180		140	128
1927	131	134	138	130	113	162	202	146	124	141	137	146	214	156	178	211		154	127
1928	142	148	145	131	144	148	180	122	128	142	135	149	127	143	173	145		147	129
1929	143	149	148	130	139	149	168	121	136	137	128	171	190	165	153	190		146	128
1930	128	129	132	123	100	110	94	108	104	126	95	163	171	158	150	150		115	121
1931	101	101	98	103	57	76	56	107	71	72	40	88	63	86	115	98		83	104
1932	90	74	74	76	30	104	68	98	59	66	46	68	87	81	79	86		74	89
1933	70	65	69	78	70	99	104	104	105	89	58	96	92	95	82	73		90	87
1934	70	70	82	85	91	107	126	79	111	124	132	109	65	90	87	129		98	96
1935	95	92	103	95	87	104	111	105	96	101	123	85	89	92	103	91		102	99
1936	99	95	102	100	100	123	126	119	122	127	136	128	158	100	106	127		116	99
1937	107	107	110	107	130	90	85	96	93	99	80	101	82	115	94	85		96	105
1938	97	99	97	96	87	87	87	87	88	80	84	94	76	79	101	99		90	99
1939	99	105	90	99	91	93	91	94	100	97	77	92	95	119	96	100	100	95	98
1940	103	106	93	109	104	100	98	90	115	97	85	112	103	117	104	101	141	101	99
1941	123	138	108	116	148	157	174	129	180	116	173	106	77	125	86	104	233	146	105
1942	157	178	140	142	165	178	190	143	219	138	163	147	141	151	127	160	160	172	121
1943	188	204	174	170	183	206	198	152	245	201	199	266	199	349	225	210	257	200	136
1944	166	187	172	131	209	210	210	163	243	207	196	213	154	254	287	195	264	196	145
1945	195	211	194	175	209	214	229	182	248	202	192	215	244	271	290	220	219	208	151
1946	231	253	206	224	209	285	336	222	304	252	233	231	165	274	293	320	231	268	165
1947	275	319	227	260	187	299	328	234	349	293	291	224	202	254	255	246	164	291	192
1948	287	322	236	285	196	268	316	193	297	238	240	235	242	292	289	128	128	274	207
1949	285	349	212	264	196	249	297	201	266	202	163	249	242	266	299	178	164	261	200
1950	287	380	178	258	239	314	407	254	309	220	272	144	195	237	274	275	241	305	204
1951	331	451	201	282	454	293	376	193	277	250	233	419	211	289	265	201	241	305	225
1952	303	381	188	300	226	315	370	218	340	265	245	401	327	402	317	208	197	311	229
1953	250	265	189	287	248	284	335	232	305	228	198	278	139	349	292	163	167	273	221
1954	236	262	166	263	243	271	343	219	260	213	205	272	170	211	226	270	149	260	221
1955	229	244	171	262	196	262	331	205	284	171	162	146	335	224	312	307	-	253	220
1956	220	231	156	266	169	277	324	254	293	189	187	208	301	315	304	190	138	259	222
1957	235	268	157	263	222	275	310	218	322	195	175	264	153	309	339	232	123	262	228
1958	280	355	156	291	161	271	324	237	302	183	152	179	189	246	306	285	128	274	234
1959	277	364	131	291	157	276	335	224	283	182	145	129	219	484	287	338	131	276	

Table 28. Index numbers of purchasing power per unit of farm products, Louisiana, 1910-1959

(Crop year 1935-39=100)

ear	Livestock & products	Meat animals	Poultry & eggs	Dairy products	Wool	Crops	Cotton lint	Sugar cane	Food grains	Feed & hay	Oil bearing crops	Sweetpotatoes	Irish potatoes	Vegetables	Fruits	Pecans	Tung nuts	All farm products
910		129	123	130	118		173	157	121	127	119	131	129	118	121			153
911		110	112	129	87		153	177	114	119	96	136	138	129	119			138
912		111	111	125	84		126	149	149	135	79	136	172	131	91			142
913		123	119	123	77		141	128	146	132	85	128	153	128	172			140
914		138	116	123	78		120	149	133	135	76	121	150	127	113			122
915		126	105	125	79		100	175	145	136	95	101	158	117	105			140
916		126	113	112	89		138	184	124	115	151	115	155	117	85			168
917		139	106	104	122		175	191	165	153	166	140	278	152	98			208
918		138	110	109	139		202	169	184	158	164	157	93	136	125			180
919		124	114	113	106		181	281	184	141	139	152	146	143	130			220
920		110	116	113	60		177	115	159	123	109	100	162	148	126			102
921		99	110	126	40		94	98	90	97	60	100	166	137	160			115
922		86	104	112	53		146	153	105	91	86	108	141	121	121			146
923		85	111	109	81		198	177	108	109	95	143	145	139	139			170
924	94	84	109	106	95	152	174	135	140	135	105	196	124	174	158	214		135
925	96	90	115	96	130	136	149	97	154	118	103	182	128	157	140	157		124
926	102	97	117	103	91	112	98	120	118	107	75	122	198	144	148	141		109
927	103	106	109	102	89	128	159	115	98	111	108	115	169	123	140	166		121
928	110	115	112	102	112	115	140	95	99	110	105	116	98	111	134	112		114
929	112	116	116	102	109	116	131	95	106	107	100	134	148	129	120	148		114
930	106	107	109	102	83	91	78	89	86	104	79	135	141	131	124	124		95
931	97	97	94	99	55	73	54	103	68	69	38	85	61	83	111	94		80
932	101	83	83	85	34	117	76	110	66	74	52	76	98	91	89	97		83
933	80	75	79	90	80	114	120	120	121	102	67	110	106	109	94	84		103
934	73	73	85	89	95	111	131	82	116	129	138	114	68	94	91	134		102
935	96	93	104	96	88	105	112	106	97	102	124	86	90	93	104	92		103
936	100	96	103	101	101	124	127	120	123	128	137	129	160	101	107	128		117
937	102	102	105	102	124	86	81	91	89	94	76	96	78	110	90	81		91
938	98	100	98	97	88	88	88	88	89	81	85	95	77	80	102	100		91
939	101	107	92	101	93	95	93	96	102	99	79	94	97	121	98	102	102	97
940	104	107	94	110	105	101	99	91	116	98	86	113	104	118	105	102	142	102
941	117	131	103	110	141	150	166	123	171	110	165	101	73	119	82	99	222	139
942	130	147	116	117	136	147	157	118	181	114	135	121	117	125	105	132	132	142
943	138	150	128	125	135	151	146	112	180	148	146	196	146	257	165	154	189	147
944	114	129	119	90	144	145	145	112	168	143	135	147	106	175	198	134	182	135
945	129	140	128	116	138	142	152	121	164	134	127	142	162	179	192	146	145	138
946	140	153	125	136	127	173	204	135	184	153	141	140	100	166	178	194	140	162
947	143	166	118	135	97	156	171	122	182	153	152	117	105	132	133	128	85	152
948	139	156	114	138	95	129	153	93	143	115	116	114	117	141	140	62	62	132
949	142	174	106	132	98	124	148	100	133	101	82	124	121	133	150	89	82	130
950	141	186	87	126	117	154	200	125	151	108	133	71	96	116	134	135	118	150
951	147	200	89	125	202	130	167	86	123	111	104	186	94	128	118	89	107	136
952	132	166	82	131	99	138	162	95	148	116	107	175	143	176	138	91	86	136
953	113	120	86	130	112	129	152	105	138	103	90	126	63	158	132	74	76	124
954	107	119	75	119	110	123	155	99	118	96	93	123	77	95	102	122	67	118
1955	104	111	78	119	89	119	150	93	129	78	74	66	152	102	142	140		115
1956	99	104	70	120	76	125	146	114	132	85	84	94	136	142	137	86	62	117
1957	103	118	69	115	97	121	136	96	141	86	77	116	67	136	149	102	54	115
1958	112	152	67	100	69	117	137	103	130	79	65	93	81	105	129	122	56	116
1959																		

Table 29. Relative prices received for agricultural products by Louisiana farmers, 1910-1959

(Crop year 1935-39=100)

Crop year	Beef cattle	Veal calves	Sheep	Lambs	Hogs	Broilers	Farm Chickens	Turkeys	Eggs
					per cent				
1910	88	85	109	95	113		85		98
1911	80	82	108	89	94		87		87
1912	88	85	117	94	93		85		91
1913	101	91	111	99	101		87		99
1914	116	109	132	118	110		91		96
1915	111	106	137	140	99		86		89
1916	121	117	147	130	112		81		99
1917	152	151	184	160	179		107		134
1918	167	155	214	184	222		130		158
1919	173	155	217	180	228		157		185
1920	172	154	196	169	211		170		207
1921	117	110	134	126	132		146		134
1922	95	93	109	110	116		131	140	125
1923	96	91	147	126	118		142	142	142
1924	98	94	135	120	123		144	135	137
1925	100	102	167	148	146		146	144	152
1926	100	111	143	133	156		151	160	147
1927	121	123	151	139	153		151	158	129
1928	155	162	183	162	131		151	146	141
1929	155	166	177	164	131		152	155	145
1930	123	140	151	133	126		135	153	130
1931	100	102	114	119	101		108	109	91
1932	77	73	90	76	71		82	92	68
1933	67	71	81	77	60		71	76	68
1934	73	70	81	68	66		80	75	83
1935	89	90	89	91	96	101	95	91	109
1936	96	92	104	106	106	97	106	105	108
1937	106	104	107	100	111	114	101	105	105
1938	99	101	101	102	98	99	101	108	92
1939	110	113	99	100	88	90	100	92	86
1940	117	116	106	102	76	97	101	94	86
1941	144	147	112	109	116	104	115	118	112
1942	178	181	142	133	174	138	144	154	141
1943	217	205	164	153	203	165	189	188	181
1944	195	191	164	152	173	176	186	196	163
1945	219	208	172	177	204	186	209	206	188
1946	255	253	183	201	252	207	224	221	200
1947	308	314	188	248	344	218	236	239	237
1948	395	391	233	274	350	229	242	340	244
1949	376	365	238	297	291	193	229	231	234
1950	418	418	272	314	276	161	195	235	195
1951	501	497	333	431	311	165	190	245	250
1952	431	403	280	409	311	157	193	235	228
1953	234	259	219	316	317	144	192	210	248
1954	212	259	212	314	334	122	159	188	227
1955	216	266	180	328	247	135	160	194	222
1956	214	253	167	296	221	104	149	188	226
1957	244	288	188	318	269	100	139	174	226
1958	359	389	188	332	302	96	127	143	245
1959[1]	386	432	188	319	238	83	101	137	205

---

[1] Simple average of the 12 monthly prices.

(Continued)

Table 29. Relative prices received for agricultural products by Louisiana farmers, 1910-1959 (Continued)

(Crop year 1935-39=100)

Crop year	Cotton	Sugar cane	Sirup	Rice	Cowpeas	Oranges	Pears	Peaches	Strawberries	Pecans
					per cent					
1910	142	120	116	88				92		
1911	97	140	116	105				92		
1912	115	121	108	120				73		
1913	124	102	113	118				138		
1914	77	122	113	121				92		
1915	111	148	126	110	110			87		
1916	170	172	145	129	88			78		
1917	267	231	155	256	144			115		
1918	289	237	179	234	160			128	172	
1919	362	456	282	337	189	208	189	165	187	302
1920	170	188	253	153	228	130	265	248	201	323
1921	161	118	142	130	148	178	347	133	195	219
1922	228	190	129	129	132	171	259	133	129	226
1923	280	231	155	148	147	63	258	174	180	195
1924	223	182	113	179	229	128	288	170	195	274
1925	195	132	92	202	216	166	220	161	180	206
1926	126	160	108	151	165	157	197	138	200	180
1927	202	150	116	124	147	262	212	165	156	211
1928	180	126	97	127	164	187	205	147	180	145
1929	168	123	108	136	172	213	205	156	132	190
1930	94	110	95	104	148	114	197	161	153	150
1931	56	107	103	71	82	99	136	96	123	98
1932	68	100	89	59	70	96	106	96	72	86
1933	104	107	87	105	98	107	152	100	78	73
1934	126	76	97	111	119	79	83	69	83	129
1935	110	104	105	96	107	121	114	96	101	91
1936	126	121	95	122	121	121	98	101	104	127
1937	85	95	108	93	100	102	106	115	92	85
1938	87	87	100	88	90	75	76	92	105	99
1939	91	94	92	100	82	82	106	96	97	100
1940	98	89	105	115	90	75	76	92	108	101
1941	174	128	147	180	124	90	91	96	85	104
1942	190	142	163	220	150	168	99	119	123	160
1943	198	150	195	245	200	254	258	284	217	210
1944	210	162	174	243	204	194	189	275	295	195
1945	229	182	195	248	210	190	197	271	304	220
1946	336	213	316	313	262	142	227	280	311	320
1947	328	236	211	349	291	131	219	261	269	246
1948	316	192	211	297	263	138	189	266	310	128
1949	297	202	184	266	216	164	197	257	318	178
1950	407	257	211	309	264	160	197	312	287	275
1951	376	191	224	277	285	284	235	312	262	201
1952	370	216	247	337	274	261	227	303	326	208
1953	335	231	245	305	271	257	220	261	297	163
1954	343	218	229	262	268	216	204	335	224	270
1955	331	204	229	280	229	190	220	1/	339	1/
1956	324	253	216	293	256	287	205	303	307	190
1957	310	218	226	322	268	246	227	307	352	232
1958	324	238	232	302	287	287	197	220	312	285
1959	335	221	226	284	244	281 2/	197	229	290	338

(Continued)

1/ Crop failure.
2/ 1958 price relative.

Table 29. Relative prices received for agricultural products by Louisiana farmers, 1910-1959 (Continued)

(Crop year 1935-39=100)

Crop year	Corn	Oats	Hay	(Whole-sale) Milk	(Retail) Milk	Butter	Butterfat	Wool	Cotton-seed	Soy-bean
					per cent					
1910	89	122	116	110	93	91	107	96	104	
1911	109	135	131	109	92	90	95	70	73	
1912	104	128	129	148	92	99	109	70	77	
1913	117	122	129	110	89	98	112	61	76	
1914	124	135	126	111	91	99	106	61	62	
1915	103	139	124	119	92	101	106	65	111	
1916	161	133	123	118	91	103	113	91	174	
1917	231	196	174	138	107	124	142	152	248	
1918	246	228	217	175	124	151	175	191	264	
1919	247	228	234	217	138	170	216	161	263	
1920	141	237	188	226	160	178	221	122	118	
1921	103	135	137	178	135	145	161	52	112	
1922	134	133	143	146	123	130	155	65	115	
1923	156	143	151	149	125	145	169	87	164	
1924	174	152	186	142	127	161	161	122	127	206
1925	144	150	182	128	124	157	153	170	125	220
1926	129	133	163	133	131	154	161	117	87	177
1927	141	139	141	128	135	157	165	113	133	172
1928	140	157	137	130	135	154	165	143	129	185
1929	136	148	133	130	131	150	165	139	121	195
1930	127	124	124	121	129	146	141	100	87	169
1931	63	80	89	100	113	111	97	57	31	110
1932	63	65	76	69	94	82	65	30	41	83
1933	90	98	80	71	79	79	65	70	50	124
1934	130	135	99	81	96	86	77	91	129	157
1935	101	107	97	92	99	101	97	87	124	123
1936	137	117	107	100	100	104	109	100	138	133
1937	94	111	104	107	103	106	117	130	77	87
1938	74	80	95	102	98	97	93	87	84	84
1939	91	87	118	100	99	93	85	91	78	73
1940	93	91	110	109	101	96	101	104	83	90
1941	119	102	96	116	107	108	121	148	194	122
1942	141	126	114	142	118	125	137	165	181	117
1943	193	191	230	173	129	160	165	183	210	173
1944	199	213	225	125	131	162	181	209	204	175
1945	199	185	222	180	135	170	190	209	203	164
1946	256	252	242	234	153	210	218	209	252	186
1947	314	248	257	271	180	1/	250	187	325	206
1948	226	230	273	297	199		236	196	272	163
1949	186	196	233	273	198		218	196	171	143
1950	209	215	253	266	204		230	239	323	145
1951	236	235	295	291	217		218	454	261	164
1952	256	228	308	310	226		210	226	275	170
1953	223	191	262	295	226		238	248	215	154
1954	204	183	253	268	224		214	243	242	158
1955	151	165	225	267	230		210	196	175	230
1956	177	159	236	271	229		206	169	209	133
1957	186	161	238	267	234		206	222	194	127
1958	170	174	224	264	234		208	161	165	120
1959	167	167	228	264 2/	237 2/		202 2/	157 2/	156	120

(Continued)

1/ Series discontinued.
2/ Simple average of the 12 monthly prices.

Table 29. Relative prices received for agricultural products by Louisiana farmers, 1910-1959 (Continued)

(Crop year 1935-39=100)

Crop year	Irish potatoes	Sweet potatoes	Cabbage	Spring beans	Fall beans	Water-melons	Green peppers	Tomatoes	Truck crops for processing
				------------ per cent ------------					
1910	99	101	-	-	-	-	-	-	91
1911	108	106	-	-	-	-	-	-	101
1912	139	110	-	-	-	-	-	-	106
1913	124	104	-	-	-	-	-	-	104
1914	123	99	-	-	-	-	-	-	104
1915	133	85	-	-	-	-	-	-	98
1916	144	107	-	-	-	-	-	-	109
1917	328	165	-	-	-	-	-	-	179
1918	129	216	276	242	-	-	-	-	187
1919	229	238	264	253	-	-	-	-	225
1920	277	171	202	242	-	-	-	-	253
1921	206	124	113	296	-	-	-	-	170
1922	171	131	100	172	175	-	-	-	147
1923	184	182	214	274	185	-	-	-	176
1924	159	251	245	194	185	-	206	-	190
1925	168	238	113	145	185	-	190	316	230
1926	253	156	177	231	165	-	222	189	196
1927	214	146	109	145	130	-	190	105	157
1928	127	149	116	167	155	-	143	132	284
1929	190	171	111	145	110	-	148	132	213
1930	171	163	180	113	103	-	111	116	150
1931	63	88	83	87	95	-	103	132	149
1932	87	68	133	59	60	-	135	153	110
1933	92	96	108	88	68	-	95	95	87
1934	65	109	53	77	80	78	76	74	100
1935	89	85	115	76	101	93	78	79	77
1936	158	128	93	129	90	103	76	105	98
1937	82	101	115	124	135	99	95	132	100
1938	76	94	73	75	80	104	79	63	104
1939	95	92	103	97	95	132	175	121	122
1940	103	112	120	124	65	144	127	84	110
1941	77	106	110	134	165	156	95	121	124
1942	141	147	83	151	190	208	183	189	175
1943	199	266	339	247	240	448	516	368	303
1944	154	213	141	242	245	461	302	342	275
1945	214	215	131	269	275	547	349	353	260
1946	165	231	201	226	240	432	349	368	326
1947	202	224	99	247	240	328	444	268	354
1948	242	235	227	296	230	460	317	368	316
1949	242	249	146	296	150	419	413	268	301
1950	195	144	77	263	220	489	238	600	186
1951	211	419	309	269	295	484	151	389	294
1952	327	401	291	290	320	437	706	579	315
1953	139	278	84	269	190	500	690	842	394
1954	170	272	127	177	245	440	182	352	316
1955	336	146	166	215	180	305	238	437	168
1956	302	208	126	296	185	432	524	821	160
1957	153	264	196	271	249	463	405	665	182
1958	189	179	191	210	204	401	254	508	183
1959	219	129	156	223	240	370	349	581	153[1]

[1] Estimated.

Table 30. Meat animals: Index numbers of prices received by Louisiana farmers, by months, 1910-1959

(Crop year 1935-39=100)

Year	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	Weighted avg.
						per cent							
1910	92	86	98	103	106	104	103	103	98	105	93	96	99
1911	94	91	86	89	84	82	81	81	91	87	83	89	86
1912	87	85	83	88	97	84	95	93	97	92	93	88	90
1913	87	91	95	89	105	103	103	104	105	110	111	100	100
1914	103	105	108	111	112	115	118	126	119	123	109	108	113
1915	107	108	105	108	105	107	118	103	102	107	100	104	106
1916	110	110	107	119	117	115	112	116	124	123	123	124	117
1917	121	128	137	148	160	164	172	164	176	206	191	196	164
1918	179	176	185	182	191	194	196	201	197	194	196	187	190
1919	186	189	188	189	205	191	212	215	197	199	184	190	195
1920	190	191	189	199	187	189	217	203	190	177	168	152	188
1921	148	146	144	122	126	122	115	112	118	109	117	99	123
1922	104	104	103	105	107	107	106	101	106	100	106	98	104
1923	103	107	108	107	106	102	114	112	116	112	98	105	108
1924	107	111	107	102	112	109	110	107	111	114	120	119	107
1925	118	115	130	132	125	135	124	115	114	124	131	127	118
1926	123	123	123	123	117	127	128	121	124	136	136	130	124
1927	127	135	130	130	122	126	123	138	141	143	146	141	134
1928	137	130	140	138	151	148	146	153	168	170	148	149	148
1929	150	146	149	150	151	151	152	155	148	151	149	147	149
1930	143	145	145	143	136	135	128	115	115	117	115	108	129
1931	115	111	112	114	115	105	111	106	96	90	90	94	101
1932	83	86	85	75	75	69	75	76	77	73	70	68	74
1933	60	61	62	64	73	70	70	70	65	67	68	63	65
1934	63	67	67	67	66	72	70	69	84	75	77	77	70
1935	81	83	93	92	97	97	95	94	104	93	99	102	92
1936	105	100	98	103	102	104	99	105	106	102	102	106	95
1937	104	106	104	110	110	110	115	119	118	116	112	105	107
1938	99	99	102	105	102	103	105	104	100	98	100	99	99
1939	102	101	107	106	107	104	101	99	107	106	103	96	105
1940	98	96	98	102	107	103	105	97	107	106	103	100	106
1941	109	115	115	127	133	135	147	145	153	150	146	147	138
1942	153	162	173	186	185	184	185	186	187	190	190	191	178
1943	203	214	227	235	232	232	221	215	212	208	198	189	204
1944	190	195	198	199	194	187	178	180	177	184	187	187	187
1945	203	208	212	212	221	220	222	224	224	216	212	224	211
1946	224	228	231	235	237	244	280	283	259	320	311	301	253
1947	286	294	320	323	316	320	324	329	333	321	319	341	319
1948	371	359	368	377	377	385	401	414	361	372	366	372	322
1949	381	358	371	370	368	364	359	354	344	328	322	316	349
1950	328	344	347	352	493	389	400	409	414	396	403	409	380
1951	421	468	484	493	475	461	449	447	446	439	318	422	451
1952	442	430	438	442	444	423	403	394	341	313	289	313	381
1953	318	307	301	297	292	262	261	253	244	234	235	289	265
1954	275	285	280	295	293	274	259	252	247	245	233	234	262
1955	240	258	253	260	254	242	253	249	240	239	223	219	244
1956	224	231	220	239	242	241	235	234	235	226	218	222	231
1957	242	242	249	265	268	267	270	285	288	277	279	287	268
1958	308	329	347	353	367	353	366	364	365	370	374	375	355
1959	369	373	378	384	391	384	379	362	361	341	329	310	364 1/

1/ Simple average of the 12 monthly prices.

Table 31. Beef cattle: Relative prices received by Louisiana farmers, by months, 1910-1959

(Crop year 1935-39=100)

Year	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	Weighted avg.
						------------ per cent ------------							
1910	86	75	79	79	99	97	97	98	94	90	77	88	88
1911	86	86	75	86	79	77	75	73	84	77	79	84	80
1912	84	81	79	88	97	84	95	92	95	88	88	84	88
1913	79	90	94	90	110	105	105	101	110	110	116	97	101
1914	103	103	112	112	116	121	121	132	116	132	110	112	116
1915	112	114	108	116	110	114	125	105	101	114	103	114	111
1916	119	119	116	130	127	119	119	119	123	121	114	121	121
1917	119	130	132	134	149	167	167	152	147	187	167	174	152
1918	163	152	156	156	163	176	187	189	171	176	165	147	167
1919	158	171	176	165	187	167	187	189	174	174	160	167	173
1920	165	176	176	191	165	169	213	193	165	165	149	141	172
1921	138	143	136	127	127	123	105	108	110	97	105	86	117
1922	99	101	92	97	99	103	101	97	94	86	90	84	95
1923	92	97	90	88	90	90	110	105	103	101	92	99	96
1924	103	105	101	94	108	101	103	94	99	103	110	101	98
1925	103	92	116	121	105	121	103	92	99	101	110	99	100
1926	101	97	99	101	99	112	97	90	103	110	110	105	100
1927	99	110	112	116	110	116	114	127	132	132	138	141	121
1928	141	136	149	143	167	165	152	165	178	189	158	163	155
1929	160	160	160	163	165	160	165	163	158	158	158	158	155
1930	154	152	149	147	136	132	121	103	103	103	101	99	123
1931	116	110	116	119	119	108	110	99	94	90	92	84	100
1932	86	92	90	77	77	77	81	79	80	77	75	71	77
1933	64	64	65	70	81	74	74	74	66	68	69	65	67
1934	66	70	70	70	71	80	74	71	85	75	78	78	73
1935	78	82	95	96	105	98	96	92	96	87	89	95	89
1936	105	99	92	105	99	103	97	99	103	95	95	101	96
1937	100	105	101	116	112	108	114	116	119	114	108	103	106
1938	102	100	104	110	105	103	105	105	97	97	97	102	99
1939	110	110	116	119	121	114	110	110	119	116	116	109	110
1940	116	114	119	125	130	125	127	112	125	125	120	114	117
1941	123	132	134	147	152	152	160	156	163	158	154	156	144
1942	163	174	182	196	191	191	182	182	187	187	187	189	178
1943	209	222	237	253	248	257	233	224	215	213	198	193	217
1944	200	213	224	220	213	207	193	191	185	187	187	189	195
1945	209	220	226	224	233	233	235	237	240	220	209	231	219
1946	229	237	244	248	250	262	290	281	257	275	292	286	255
1947	276	280	306	323	321	318	318	318	318	297	297	329	308
1948	378	372	382	403	399	414	416	420	382	391	360	389	395
1949	399	384	395	401	406	393	382	372	361	350	340	340	376
1950	363	380	391	395	569	429	429	433	442	425	446	456	418
1951	469	524	552	569	544	510	499	484	488	480	340	467	501
1952	499	499	510	518	512	478	446	425	382	329	287	340	431
1953	331	312	297	287	268	217	221	208	206	195	191	291	234
1954	221	231	234	234	234	217	204	204	202	202	189	191	212
1955	204	223	221	229	221	227	214	219	214	217	204	210	216
1956	214	221	221	223	227	219	212	219	217	204	202	197	214
1957	219	219	227	242	244	242	255	253	259	257	257	274	244
1958	308	329	361	359	378	346	365	363	360	380	384	386	359
1959	389	393	406	410	414	401	399	389	380	363	352	340	386[1/]

[1/] Simple average of the 12 monthly prices.

Table 32. Veal calves: Relative prices received by Louisiana farmers, by months, 1910-1959

(Crop year 1935-39=100)

Year	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	Weighted avg.
						per cent							
1910	81	71	71	88	85	97	87	96	83	88	81	90	85
1911	85	83	74	74	74	74	87	80	101	83	80	90	82
1912	92	81	88	81	87	85	92	78	94	88	80	71	85
1913	67	78	85	71	106	99	97	97	88	119	101	85	91
1914	97	99	104	112	103	106	112	163	106	110	110	90	109
1915	103	104	101	110	108	106	117	104	108	106	94	106	106
1916	112	117	103	127	117	106	113	110	124	113	133	131	117
1917	124	122	154	158	168	143	161	142	154	154	166	163	151
1918	159	142	145	140	168	175	182	159	149	170	136	136	155
1919	138	145	150	152	163	152	159	166	158	165	168	147	155
1920	152	179	161	181	181	147	159	150	143	149	120	131	154
1921	129	136	131	127	122	113	101	87	94	94	81	101	110
1922	85	85	92	106	104	119	101	87	94	90	87	67	93
1923	80	90	92	90	99	92	97	96	90	92	88	88	91
1924	92	103	99	101	106	104	103	85	104	99	97	92	94
1925	92	106	106	127	112	115	104	76	94	124	124	104	102
1926	97	124	106	115	104	124	106	119	117	129	112	99	111
1927	106	124	120	104	99	119	112	129	140	142	140	129	123
1928	145	142	163	159	166	170	170	168	184	184	159	159	162
1929	170	161	173	177	188	182	177	181	172	165	166	163	166
1930	177	175	170	165	158	161	165	140	138	140	126	115	140
1931	113	108	112	119	126	108	129	115	106	97	92	90	102
1932	88	88	88	74	74	72	79	73	72	72	72	70	73
1933	72	73	69	70	85	73	78	81	77	69	68	65	71
1934	70	73	73	64	65	65	70	73	79	75	81	86	70
1935	86	86	86	88	97	101	90	92	104	87	96	104	90
1936	96	94	99	99	99	103	97	96	97	88	85	92	92
1937	103	101	101	112	113	103	104	112	115	110	110	103	104
1938	99	103	101	112	110	106	106	103	103	94	103	99	101
1939	108	110	120	122	122	122	117	113	126	119	112	108	113
1940	112	117	115	122	129	126	127	119	122	120	117	119	116
1941	126	135	136	147	152	150	159	158	165	165	175	159	147
1942	168	177	181	195	196	191	189	189	184	188	188	191	181
1943	198	209	218	230	230	239	228	214	212	205	200	191	205
1944	200	204	207	216	211	202	200	193	193	188	195	195	191
1945	209	211	214	219	219	221	221	221	218	212	211	212	208
1946	221	228	235	235	239	248	274	258	258	294	281	281	253
1947	290	290	307	314	314	324	331	326	328	307	307	329	314
1948	379	369	377	392	399	398	415	427	379	367	372	379	391
1949	403	372	384	384	392	384	375	372	358	338	341	341	365
1950	357	381	381	392	544	433	432	442	442	427	432	449	418
1951	464	520	532	544	522	522	495	495	495	481	321	469	497
1952	495	495	486	486	481	461	435	418	358	316	299	324	403
1953	324	316	307	304	290	247	263	239	213	208	213	307	259
1954	276	271	285	290	283	265	247	249	247	247	224	234	259
1955	251	278	271	283	280	273	275	271	254	254	246	246	266
1956	254	258	263	270	273	265	259	247	247	239	230	239	253
1957	259	259	261	290	294	287	299	302	307	294	305	309	288
1958	331	358	367	382	396	387	398	391	403	406	411	422	389
1959	423	433	444	450	461	461	459	452	439	410	384	358	432[1]

[1] Simple average of the 12 monthly prices.

Table 33. Hogs: Relative prices received by Louisiana farmers, by months, 1910-1959

(Crop year 1935-39=100)

Year	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	Weighted avg.
						per cent							
1910	102	100	123	133	118	113	113	112	105	120	112	105	113
1911	103	98	100	95	90	88	87	90	97	98	88	95	94
1912	90	88	85	88	98	85	95	97	100	98	100	97	93
1913	98	93	97	90	98	100	100	108	102	108	107	107	101
1914	103	108	105	108	108	108	115	113	123	113	107	105	110
1915	102	100	100	97	98	98	108	98	100	98	97	92	99
1916	100	98	97	105	105	112	103	113	113	127	132	127	112
1917	123	127	140	162	170	163	180	182	213	223	228	228	179
1918	200	210	223	218	227	218	207	222	233	218	242	242	222
1919	225	217	208	222	232	223	250	253	232	233	213	223	228
1920	225	212	208	212	213	217	230	222	227	197	197	168	211
1921	162	152	155	113	125	122	128	120	132	125	135	113	132
1922	113	112	118	113	117	108	112	108	122	118	127	120	116
1923	120	122	113	113	108	117	120	122	133	127	105	113	118
1924	115	118	115	110	117	118	118	125	127	128	133	142	123
1925	137	142	148	145	148	153	150	147	133	150	155	162	146
1926	150	152	153	150	140	145	167	157	147	167	170	163	156
1927	162	165	152	150	140	137	135	152	152	155	155	143	153
1928	132	122	125	128	128	125	135	137	153	145	133	130	131
1929	133	125	130	130	128	135	132	142	132	140	135	132	131
1930	123	132	135	133	132	133	132	123	125	130	128	117	126
1931	113	112	107	108	108	100	108	113	97	90	87	83	101
1932	78	78	78	72	72	60	67	73	73	68	65	64	71
1933	54	55	57	56	62	64	64	63	62	65	65	59	60
1934	59	61	62	63	60	64	66	66	83	76	76	75	66
1935	83	83	92	88	87	95	95	97	113	102	112	110	96
1936	107	102	103	100	105	105	102	113	110	112	113	113	106
1937	112	107	107	103	107	115	117	123	118	118	118	108	111
1938	97	97	98	98	97	102	103	103	103	100	103	95	98
1939	92	90	93	88	88	88	88	83	92	94	87	78	88
1940	74	71	71	72	78	72	76	76	82	82	82	82	76
1941	90	92	90	102	110	115	130	132	140	138	135	135	116
1942	140	148	163	175	177	177	188	192	188	195	195	195	174
1943	200	207	218	217	215	212	207	207	208	203	200	183	203
1944	177	173	167	173	170	163	157	165	167	177	182	183	173
1945	195	195	195	198	208	205	208	210	210	213	217	220	204
1946	220	220	217	220	222	225	270	292	262	378	340	323	252
1947	292	317	359	337	314	321	321	350	360	375	367	377	344
1948	385	329	336	321	317	331	364	387	306	355	355	341	350
1949	326	302	302	299	284	297	304	306	299	286	269	248	291
1950	241	241	241	236	316	270	316	329	337	314	306	287	276
1951	292	317	321	316	312	307	314	327	316	324	286	292	311
1952	289	277	272	274	291	296	297	317	292	286	277	259	311
1953	277	287	297	302	329	342	346	332	341	324	324	259	317
1954	347	364	371	384	387	365	350	322	306	299	306	291	334
1955	274	276	256	267	261	214	274	256	254	246	216	191	247
1956	191	204	191	214	214	236	228	233	241	236	221	231	221
1957	249	249	248	257	262	271	284	302	299	279	271	271	269
1958	276	286	299	304	312	314	324	327	306	306	306	296	302
1959	274	257	246	254	261	249	234	228	224	211	218	201	238[1]

---

[1] Simple average of the 12 monthly prices.

Table 34. Sheep: Relative prices received by Louisiana farmers, by months, 1910-1959

(Crop year 1935-39=100)

Year	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	Weighted avg.
					-------------	per cent	-------------						
1910	112	125	128	123	115	93	93	96	120	107	133	60	109
1911	133	88	80	93	93	93	93	131	139	128	112	115	108
1912	120	125	131	128	109	107	107	80	160	101	133	101	117
1913	93	128	80	96	105	120	107	123	125	101	120	131	111
1914	123	120	96	157	136	147	131	155	120	133	131	133	132
1915	133	160	123	168	88	155	149	152	133	133	120	133	137
1916	120	147	136	149	168	133	147	147	144	144	173	155	147
1917	155	160	160	147	195	181	197	192	181	200	232	205	184
1918	200	195	221	176	235	240	251	219	213	224	213	187	214
1919	224	187	213	229	235	229	205	216	200	213	235	219	217
1920	205	192	176	197	195	235	240	208	173	176	187	168	196
1921	160	160	149	149	139	155	120	117	128	99	125	112	134
1922	125	88	83	123	139	93	115	128	107	99	123	88	109
1923	107	133	160	171	187	173	160	147	133	115	133	141	147
1924	120	128	133	139	147	133	120	133	133	149	165	187	135
1925	203	213	187	160	133	160	187	173	157	160	160	187	167
1926	205	192	179	120	123	112	109	147	200	147	181	155	143
1927	123	133	139	160	149	160	133	160	157	147	149	141	151
1928	139	139	187	160	176	187	176	187	200	213	200	211	183
1929	195	189	197	187	181	179	176	173	171	173	181	181	177
1930	184	181	171	168	149	149	139	152	163	136	133	141	151
1931	144	131	139	141	147	125	109	99	69	64	80	80	114
1932	88	107	104	99	93	88	85	91	79	83	95	93	90
1933	77	76	72	79	69	75	77	85	88	76	85	80	81
1934	87	88	80	80	77	72	71	79	76	73	81	89	81
1935	104	104	104	83	84	84	84	80	85	99	99	101	89
1936	107	107	96	101	108	108	104	107	104	109	101	108	104
1937	108	115	112	109	112	104	107	107	120	115	96	107	107
1938	107	112	99	100	100	99	107	107	101	101	101	85	101
1939	93	93	100	100	100	100	100	97	101	104	107	107	99
1940	107	112	112	107	106	104	112	107	107	100	101	96	106
1941	107	109	112	112	107	107	115	115	116	117	117	117	112
1942	123	128	128	147	160	141	141	149	149	149	149	152	142
1943	155	160	160	179	165	173	173	165	160	160	160	173	164
1944	160	165	165	173	160	168	163	157	160	173	173	173	164
1945	179	187	194	187	181	176	173	152	147	155	155	155	172
1946	155	160	160	175	176	176	197	189	195	200	187	187	183
1947	185	185	185	185	185	185	185	185	185	193	193	204	188
1948	212	212	222	222	225	225	235	251	235	241	235	228	233
1949	228	228	241	243	257	251	251	235	222	222	222	220	238
1950	238	259	259	272	344	270	265	265	278	278	291	317	272
1951	317	317	344	344	344	344	331	331	331	331	233	331	333
1952	331	331	331	310	317	259	259	259	259	233	233	233	280
1953	233	238	235	238	238	206	206	206	206	201	206	233	219
1954	225	225	225	228	230	222	212	188	180	180	190	183	212
1955	193	193	193	204	190	185	172	172	159	159	164	159	180
1956	159	159	172	190	185	172	159	153	159	161	161	169	167
1957	185	185	185	185	180	185	185	198	185	190	198	198	188
1958	198	190	190	190	190	188	188	188	188	188	188	188	188
1959	188	188	188	188	188	185	185	185	185	185	190	185	188[1]

---

[1] Simple average of the 12 monthly prices.

Table 35. Lambs: Relative prices received by Louisiana farmers, by months, 1910-1959

(Crop year 1935-39=100)

Year	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	Weighted avg.
						------------- per cent -------------							
1910	83	94	96	92	89	81	75	81	102	104	113	132	95
1911	100	66	66	83	104	87	91	96	108	94	89	85	89
1912	96	100	102	96	104	92	89	75	123	75	100	75	94
1913	81	96	113	94	86	102	100	94	104	113	100	108	99
1914	111	100	87	136	113	119	125	132	151	132	102	104	118
1915	106	132	100	151	98	138	147	170	166	162	157	151	140
1916	113	125	108	132	138	119	123	134	151	119	151	147	130
1917	142	151	158	157	170	164	160	170	136	151	170	164	160
1918	164	160	204	170	198	204	208	189	185	187	170	175	184
1919	179	151	170	208	213	230	196	162	143	155	170	179	180
1920	175	172	170	179	198	202	189	157	132	170	151	134	169
1921	147	158	170	119	136	136	109	96	115	102	123	98	126
1922	113	98	89	143	147	128	119	109	96	94	104	75	110
1923	94	113	85	132	142	149	153	142	132	128	125	121	126
1924	113	113	121	126	128	128	132	104	109	123	142	151	120
1925	160	170	160	151	142	151	160	142	126	132	170	179	148
1926	146	123	132	140	102	120	138	143	160	143	160	151	133
1927	138	113	151	155	143	132	113	132	149	164	179	151	139
1928	138	130	143	158	211	200	175	179	189	181	189	181	162
1929	174	172	185	170	174	183	187	189	160	179	189	179	164
1930	172	175	153	157	143	138	113	130	126	132	147	149	133
1931	140	126	113	132	138	134	126	113	98	87	98	98	119
1932	106	115	89	89	79	77	72	72	72	66	73	72	76
1933	65	71	75	77	81	82	83	83	70	73	79	79	77
1934	79	90	87	72	70	70	67	67	63	43	63	88	68
1935	104	98	94	94	85	89	81	81	81	113	113	113	91
1936	130	130	113	113	113	106	106	108	104	94	113	96	106
1937	92	98	98	100	113	106	98	109	109	109	102	102	100
1938	100	100	100	100	111	111	104	98	94	98	98	94	102
1939	94	94	102	108	108	108	108	104	106	104	104	104	100
1940	106	106	108	108	108	106	104	106	100	98	102	98	102
1941	102	100	106	108	113	113	111	113	117	117	121	126	109
1942	130	119	113	132	140	142	138	138	132	136	136	138	133
1943	138	151	153	155	147	162	181	168	160	170	170	162	153
1944	164	168	164	164	151	158	158	168	162	159	151	151	152
1945	168	177	189	185	185	185	183	181	177	174	177	177	177
1946	177	185	185	189	191	192	215	211	211	240	240	240	201
1947	224	226	235	215	221	259	259	255	265	246	178	246	248
1948	246	221	239	246	257	265	292	301	297	288	281	270	274
1949	270	270	277	299	299	299	290	297	297	297	301	301	297
1950	307	316	316	334	449	314	294	274	292	301	334	369	314
1951	369	398	493	449	443	431	429	411	420	423	350	429	431
1952	420	456	434	434	436	416	416	423	416	350	350	334	409
1953	350	328	310	328	328	328	350	318	301	276	276	334	316
1954	307	328	356	356	328	319	319	292	274	274	265	255	314
1955	292	323	323	356	347	292	328	328	312	312	308	301	328
1956	301	301	305	308	310	310	301	292	292	292	283	274	296
1957	292	292	310	328	328	310	310	319	319	323	339	328	318
1958	338	338	338	319	323	323	328	338	338	341	341	328	332
1959	319	319	328	332	338	328	321	319	316	310	310	301	319 1/

1/ Simple average of the 12 monthly prices.

Table 36. Poultry and eggs: Index numbers of prices received by Louisiana farmers, by months, 1910-1959

(Crop year 1935-39=100)

Year	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	Weighted avg.
						per cent							
1910	110	99	89	85	86	86	82	86	90	101	109	116	95
1911	108	93	78	78	75	71	74	78	87	94	102	109	87
1912	113	101	85	77	74	70	78	79	87	98	107	107	90
1913	108	93	85	74	78	78	84	94	105	101	120	131	96
1914	117	102	83	79	83	84	81	83	104	102	97	124	95
1915	110	92	72	75	70	74	71	78	89	107	106	116	88
1916	117	87	76	78	74	78	78	86	98	115	124	150	105
1917	125	124	99	97	108	119	110	79	135	154	163	186	125
1918	176	170	118	125	128	119	132	143	150	169	193	199	152
1919	216	173	137	142	148	149	161	180	199	205	211	231	179
1920	246	211	167	168	168	170	168	193	189	217	224	263	199
1921	215	138	136	99	97	110	111	113	136	142	160	185	137
1922	146	134	86	97	88	107	106	115	139	145	168	181	126
1923	159	146	115	109	108	122	118	123	147	166	179	201	141
1924	174	171	112	108	113	114	116	121	146	174	168	205	140
1925	190	172	116	153	121	122	121	139	166	175	183	213	151
1926	177	148	116	113	123	124	127	132	158	170	175	198	150
1927	177	140	98	108	101	108	114	126	148	163	172	187	138
1928	179	127	121	114	114	119	127	134	154	166	178	182	145
1929	160	127	132	111	117	121	127	137	156	169	174	201	148
1930	182	159	109	113	109	110	106	110	124	130	133	142	132
1931	117	86	82	85	78	85	81	86	94	102	112	116	98
1932	98	65	52	56	53	54	53	60	80	90	100	114	74
1933	101	54	46	48	53	54	62	74	83	84	92	101	69
1934	87	79	60	61	62	69	73	76	101	103	108	124	82
1935	109	109	78	86	93	91	92	99	112	118	125	142	103
1936	112	102	85	83	84	70	95	103	115	120	131	159	102
1937	116	100	86	89	84	86	91	97	110	120	119	134	110
1938	104	80	74	78	81	81	83	91	104	111	117	130	97
1939	101	81	75	75	76	78	82	89	101	107	112	119	90
1940	97	112	71	71	76	76	78	87	97	104	111	123	93
1941	108	82	77	91	89	96	113	119	135	146	159	182	108
1942	148	120	110	118	120	126	128	130	152	170	180	194	140
1943	180	164	155	162	162	162	165	170	189	208	220	229	174
1944	217	164	152	131	139	144	144	152	171	194	215	226	172
1945	224	176	152	155	161	165	178	195	213	228	243	264	194
1946	244	192	155	160	167	176	205	219	238	249	265	262	206
1947	266	239	203	204	207	214	227	248	283	298	297	326	227
1948	313	277	222	214	213	219	224	250	237	278	296	314	236
1949	281	242	206	204	206	208	221	237	267	283	296	292	212
1950	218	183	172	173	201	174	191	217	241	250	259	330	178
1951	276	243	212	209	215	218	228	242	262	288	271	323	201
1952	271	216	187	188	183	187	218	244	261	268	281	296	188
1953	273	229	214	207	210	215	228	238	249	271	279	292	189
1954	202	187	162	158	157	162	168	172	168	164	165	165	166
1955	168	172	179	170	166	151	168	173	177	177	179	172	171
1956	175	166	156	149	151	148	152	152	149	158	165	167	156
1957	274	152	139	135	137	142	146	153	152	153	165	172	157
1958	172	164	163	154	154	156	147	147	150	150	152	157	156
1959	151	127	136	127	118	115	122	123	127	132	132	144	131[1/]

[1/] Simple average of the 12 monthly prices.

Table 37. Farm chickens: Relative prices received by Louisiana farmers, by months, 1910-1959

(Crop year 1935-39=100)

Year	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	Weighted avg.
						per cent							
1910	78	80	82	84	88	89	85	86	88	81	88	86	85
1911	84	85	84	86	89	88	83	86	91	92	91	90	87
1912	90	88	81	80	82	80	86	90	91	89	82	82	85
1913	85	83	82	84	84	86	95	90	89	86	89	90	87
1914	92	90	92	90	91	97	98	92	84	94	86	91	91
1915	78	82	90	90	84	86	87	82	83	81	95	88	86
1916	93	90	74	84	82	86	84	85	92	99	92	107	81
1917	95	92	95	105	105	119	110	104	122	108	114	118	107
1918	107	114	112	110	124	121	146	144	142	142	150	145	130
1919	153	144	131	121	147	154	157	176	196	170	163	170	157
1920	170	165	152	173	173	181	191	187	168	157	154	163	170
1921	163	157	161	150	137	163	150	124	144	137	138	129	146
1922	138	119	121	120	95	148	127	133	144	137	139	152	131
1923	131	124	133	124	118	150	163	137	163	163	146	148	142
1924	137	150	137	135	144	146	141	144	157	157	146	146	144
1925	144	140	139	139	162	167	147	141	148	142	150	149	146
1926	133	132	141	145	156	161	157	163	163	163	158	144	151
1927	152	148	144	156	159	156	148	150	150	149	156	144	151
1928	144	140	146	148	149	153	157	152	158	154	154	153	151
1929	150	148	146	149	159	162	158	152	152	149	151	148	152
1930	143	146	141	142	143	145	127	127	125	124	116	110	135
1931	109	106	110	117	116	120	110	105	101	99	103	97	108
1932	92	91	82	84	90	82	78	71	78	80	75	73	82
1933	69	67	64	69	75	75	73	72	72	68	69	67	71
1934	73	75	72	78	82	84	82	77	85	83	85	85	80
1935	86	87	89	98	99	103	97	94	103	101	110	111	95
1936	106	103	108	108	110	108	107	106	106	103	103	103	106
1937	100	95	98	101	103	103	100	101	107	108	103	105	101
1938	101	102	102	106	108	107	99	95	100	99	99	101	101
1939	96	95	99	104	103	103	101	100	102	102	98	95	100
1940	93	98	93	97	108	107	102	95	99	102	101	104	101
1941	98	99	102	108	115	116	118	114	120	120	125	127	115
1942	125	129	129	138	144	144	144	140	145	151	154	156	144
1943	158	167	177	197	199	196	196	189	189	191	188	188	189
1944	189	181	181	181	183	183	184	188	188	184	191	192	186
1945	191	190	194	194	203	207	217	224	224	209	216	229	209
1946	221	216	209	216	216	222	242	242	229	229	229	229	224
1947	194	194	222	233	244	250	248	242	259	240	226	239	236
1948	239	239	237	239	242	238	245	261	231	252	240	257	242
1949	248	233	233	230	242	241	237	231	232	229	228	222	229
1950	208	205	217	216	224	200	205	212	220	218	218	204	195
1951	218	210	229	222	226	224	200	207	208	182	209	197	190
1952	227	219	202	175	178	178	198	204	205	195	202	216	193
1953	200	200	185	188	182	175	180	180	176	186	176	198	192
1954	176	176	163	163	163	163	157	157	157	150	150	144	159
1955	160	163	163	167	163	157	161	167	160	160	154	154	160
1956	163	163	163	157	157	150	150	150	144	150	150	150	149
1957	147	147	147	137	137	137	137	134	144	134	141	137	139
1958	134	134	137	137	134	134	134	121	121	118	101	98	127
1959	111	105	108	108	98	98	98	95	92	98	98	101	101[1]

---

[1] Simple average of the 12 monthly prices.

Table 38. Commercial broilers: Relative prices received by Louisiana farmers, by months, 1954-1959

(Crop year 1935-39=100)

Year	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	Weighted avg.
						per cent							
1954	133	125	122	128	122	128	141	136	122	112	112	101	122
1955	122	130	157	152	149	114	141	138	133	125	120	96	135
1956	104	104	112	106	114	112	112	101	93	96	101	93	104
1957	104	104	104	98	106	112	112	109	93	88	90	85	100
1958	106	109	117	98	104	112	98	93	90	80	96	96	96
1959	90	90	90	82	80	80	80	77	77	74	74	90	83 1/

1/ Simple average of the 12 monthly prices

Table 39. Turkeys: Relative prices received by Louisiana farmers, by months, 1930-1959

(Crop year 1935-39=100)

Year	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	Weighted avg.
						per cent							
1930	155	-	-	-	-	-	-	-	-	109	114	109	153
1931	119	-	-	-	-	-	-	-	-	83	98	98	109
1932	98	-	-	-	-	-	-	-	-	83	78	78	92
1933	73	67	67	67	-	-	-	-	-	73	78	67	76
1934	73	73	67	-	-	-	-	-	-	78	88	88	75
1935	88	88	88	93	-	-	-	-	-	93	109	114	91
1936	109	98	104	104	-	-	-	88	98	98	98	98	105
1937	98	93	88	93	98	98	93	93	93	98	104	104	105
1938	104	98	98	98	93	93	88	93	93	93	93	98	108
1939	98	98	98	98	98	98	88	93	93	93	93	98	92
1940	88	88	88	-	93	92	88	88	93	93	93	93	94
1941	93	93	88	93	104	93	104	98	104	98	114	119	118
1942	109	104	109	121	118	119	114	119	115	128	138	163	154
1943	155	155	155	166	166	176	171	176	166	161	176	192	188
1944	192	181	176	171	171	171	161	166	166	171	197	202	196
1945	207	192	192	181	187	187	187	202	202	197	202	207	206
1946	207	192	192	182	192	192	197	187	192	202	233	212	221
1947	204	229	194	194	194	194	248	194	220	220	223	249	239
1948	249	241	230	215	211	220	220	225	209	236	246	283	340
1949	257	241	236	236	225	215	215	200	230	225	230	233	231
1950	230	209	209	228	236	215	225	209	236	236	236	243	235
1951	236	236	236	236	236	236	236	236	225	230	236	251	245
1952	246	236	236	230	211	126	220	220	236	236	236	236	235
1953	236	236	225	236	230	200	199	199	204	204	200	236	210
1954	204	204	188	188	188	183	183	183	183	183	188	188	188
1955	194	194	194	199	194	188	199	188	199	199	194	194	194
1956	194	188	188	188	188	183	188	188	183	188	183	194	188
1957	199	199	199	183	183	178	178	178	194	173	194	173	174
1958	194	199	178	173	173	168	168	168	168	168	136	136	143
1959	136	136	136	136	136	136	136	136	136	131	136	152	137 1/

1/ Simple average of the 12 monthly prices.

Table 40. Eggs: Relative prices received by Louisiana farmers, by months, 1910-1959

(Crop year 1935-39=100)

Year	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	Weighted avg.
						per cent							
1910	119	105	90	86	86	86	81	86	90	105	114	124	98
1911	114	95	76	76	71	67	71	76	86	95	105	114	87
1912	119	105	86	71	71	67	76	76	86	100	114	119	91
1913	114	95	86	71	76	76	81	95	110	105	129	143	99
1914	124	105	81	76	81	81	76	81	110	105	100	133	96
1915	119	95	67	71	67	71	67	76	90	114	110	124	89
1916	124	86	76	76	71	76	76	86	100	119	133	162	99
1917	133	133	100	95	110	119	110	119	138	167	176	205	134
1918	195	186	119	129	129	119	129	143	152	176	205	214	158
1919	233	181	138	148	148	148	162	181	200	214	224	248	185
1920	267	224	171	167	167	167	162	195	195	233	243	290	207
1921	229	133	129	86	86	95	100	110	133	143	167	200	134
1922	148	138	76	90	86	95	100	110	138	148	176	190	125
1923	167	152	110	105	105	114	114	119	143	167	190	219	142
1924	186	176	105	100	105	105	110	114	143	181	176	224	137
1925	205	181	110	157	110	110	114	138	171	186	195	233	152
1926	190	152	110	105	114	114	119	124	157	171	181	214	147
1927	186	138	86	95	86	95	105	119	148	167	176	200	129
1928	190	124	114	105	105	110	119	129	152	171	186	190	141
1929	162	129	129	100	105	110	119	133	157	176	181	219	145
1930	195	162	100	105	100	100	100	105	124	133	138	152	130
1931	119	81	75	77	67	75	73	81	92	104	115	122	91
1932	99	58	44	48	43	47	46	57	81	93	109	127	68
1933	111	50	40	41	47	48	59	74	86	89	100	113	68
1934	92	80	56	56	57	64	70	75	105	110	116	137	83
1935	116	116	74	83	91	88	91	100	114	124	130	151	109
1936	114	101	77	75	77	88	92	103	118	126	140	178	108
1937	121	101	83	86	78	81	88	96	112	124	125	144	105
1938	105	72	65	69	72	73	79	89	105	116	123	140	92
1939	102	76	67	66	68	70	76	86	101	109	117	127	86
1940	99	118	63	63	66	66	71	85	97	106	115	130	86
1941	110	77	69	86	81	91	112	121	141	155	170	200	112
1942	156	119	104	112	113	121	125	128	156	178	189	206	141
1943	188	164	150	152	152	152	156	165	190	215	230	243	181
1944	226	158	143	115	126	131	132	141	167	198	223	237	163
1945	233	171	138	143	148	152	167	187	210	234	252	276	188
1946	252	186	138	138	152	162	195	214	243	257	276	274	200
1947	277	244	198	197	199	206	223	252	292	318	318	351	237
1948	334	288	217	208	206	214	220	249	239	286	312	329	244
1949	290	244	198	196	197	199	217	239	277	299	316	312	234
1950	220	176	159	160	205	166	187	218	247	258	270	364	195
1951	292	251	207	205	211	216	235	250	277	317	287	357	250
1952	283	215	181	190	182	192	223	255	276	287	303	318	228
1953	292	236	220	210	215	226	241	254	269	295	308	318	248
1954	302	274	214	196	201	207	206	226	231	236	240	256	227
1955	231	231	213	195	181	197	203	222	241	250	265	279	222
1956	274	251	212	203	197	195	205	221	226	243	255	270	226
1957	215	215	182	183	175	184	194	215	231	246	271	297	226
1958	269	244	231	233	225	222	214	225	236	252	243	254	245
1959	244	232	204	193	173	167	185	191	203	218	218	227	205 1/

1/ Simple average of the 12 monthly prices.

Table 41. Dairy products: Index numbers of prices received by Louisiana farmers, by months, 1910-1959

(Crop year 1935-39=100)

Year	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	Weighted avg.
						per cent							
1910	106	100	104	102	94	93	94	97	100	103	106	107	100
1911	106	105	102	96	96	91	93	96	99	101	108	109	101
1912	110	105	102	100	97	93	93	96	98	104	105	106	101
1913	107	102	99	97	92	91	94	98	101	102	108	106	100
1914	107	103	100	97	93	92	94	99	102	104	107	110	101
1915	112	110	107	104	100	95	99	100	107	108	111	111	105
1916	104	104	102	100	99	97	97	102	105	109	115	118	104
1917	119	120	118	117	116	111	115	118	126	136	140	143	123
1918	149	148	143	138	137	137	139	141	150	169	173	175	150
1919	174	170	170	170	169	168	166	169	175	196	201	203	178
1920	207	202	199	199	178	177	178	179	200	207	206	188	193
1921	183	177	165	160	154	152	150	145	148	150	144	141	156
1922	141	139	136	134	130	129	131	132	134	136	139	140	135
1923	141	144	138	136	135	133	133	131	133	141	147	151	139
1924	153	152	152	141	128	127	126	127	132	136	139	136	136
1925	134	132	131	127	120	119	120	119	133	138	139	139	126
1926	140	139	137	131	131	128	131	133	135	136	139	141	132
1927	141	139	136	134	132	131	131	132	134	138	139	139	130
1928	141	138	136	134	134	131	130	131	137	138	140	140	131
1929	142	140	139	133	130	128	128	131	134	134	136	140	130
1930	136	133	131	127	124	125	125	124	125	127	127	126	123
1931	124	117	112	109	104	101	102	103	102	104	104	102	103
1932	95	92	85	83	80	75	73	76	77	79	79	80	76
1933	80	76	75	70	70	71	83	88	89	91	94	96	78
1934	88	87	83	80	80	80	81	89	93	96	99	99	85
1935	101	104	100	97	95	92	92	93	95	97	97	100	95
1936	101	98	98	95	93	96	98	102	104	108	110	109	100
1937	110	108	107	106	104	102	103	104	105	108	109	110	107
1938	110	109	106	100	98	96	96	97	96	97	100	105	96
1939	100	99	98	97	93	93	95	96	101	104	105	108	99
1940	108	107	105	103	102	102	101	102	105	107	109	110	109
1941	109	108	106	105	106	106	106	111	120	121	125	126	116
1942	127	127	127	125	122	123	125	128	135	139	143	147	142
1943	147	148	148	151	147	150	151	152	154	156	160	160	170
1944	159	159	158	156	154	151	159	155	158	160	166	162	131
1945	162	161	161	158	158	158	159	159	161	163	164	165	175
1946	162	162	163	162	167	172	199	217	227	232	240	241	224
1947	282	278	265	249	230	222	234	249	268	286	305	260	260
1948	308	291	283	268	263	270	278	279	247	298	314	314	285
1949	304	295	270	247	240	240	240	247	264	281	290	288	264
1950	271	258	250	241	266	237	241	258	274	282	288	289	258
1951	278	277	270	268	266	272	264	281	291	302	324	320	282
1952	547	303	294	284	284	284	290	295	307	322	326	322	300
1953	316	304	529	274	269	267	273	271	290	302	296	322	287
1954	284	271	263	246	248	246	248	254	273	276	280	274	263
1955	267	265	253	251	248	259	255	258	271	274	285	281	262
1956	270	261	259	251	257	257	257	261	273	280	280	277	266
1957	270	270	258	249	247	243	255	262	270	280	287	272	263
1958	280	278	260	247	244	232	240	146	272	275	273	271	291
1959	275	273	255	255	248	243	247	258	266	274	269	275	291 1/

1/ Simple average of the 12 monthly prices.

Table 42. Milk wholesale: Relative prices received by Louisiana farmers, by months, 1910-1959

(Crop year 1935-39=100)

Year	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	Weighted avg.
						per cent							
1910	117	117	117	114	100	98	98	102	107	112	117	119	110
1911	119	119	114	105	98	95	98	102	105	107	121	124	109
1912	124	117	112	110	105	98	98	100	102	112	114	114	148
1913	119	112	110	107	100	98	102	107	112	114	119	119	110
1914	121	114	112	107	100	98	102	107	112	114	119	124	111
1915	129	126	121	121	114	102	107	110	124	126	126	126	119
1916	114	114	114	112	112	110	107	114	119	126	136	136	118
1917	138	138	133	129	126	124	126	129	140	155	162	162	138
1918	174	174	167	157	157	157	157	160	176	207	207	207	175
1919	210	210	207	207	205	205	202	202	207	248	248	248	217
1920	248	248	245	245	200	200	198	198	240	243	243	207	226
1921	207	205	181	179	179	176	176	179	179	181	148	148	178
1922	150	148	148	145	145	143	143	143	145	148	148	148	146
1923	150	148	148	145	145	143	143	143	145	160	160	160	149
1924	164	160	160	157	136	133	131	131	133	136	138	138	142
1925	140	138	131	133	117	114	112	112	133	138	138	138	128
1926	140	136	136	131	131	129	126	129	133	136	138	138	133
1927	138	136	129	126	126	124	121	124	126	133	133	133	128
1928	136	133	129	126	126	124	121	124	136	136	138	138	130
1929	140	138	138	126	126	121	121	126	133	133	136	136	130
1930	136	129	126	117	117	114	114	114	119	124	126	126	121
1931	124	117	105	102	93	90	93	93	95	98	98	93	100
1932	88	83	69	64	64	60	60	62	64	69	71	71	69
1933	69	62	60	55	55	55	74	76	79	83	90	93	71
1934	79	79	76	69	67	67	71	83	90	95	98	98	81
1935	102	102	95	88	86	86	88	90	93	98	98	102	92
1936	102	98	98	93	88	93	93	102	107	110	112	112	100
1937	112	110	110	107	102	100	102	105	107	112	114	114	107
1938	117	114	110	102	100	98	95	98	98	100	105	114	102
1939	105	102	100	90	88	88	93	93	102	107	107	114	100
1940	114	112	110	105	102	102	102	105	110	114	117	117	109
1941	114	112	110	107	107	107	107	114	124	126	133	133	116
1942	136	140	138	133	126	126	131	138	150	157	164	169	142
1943	167	167	164	169	167	169	171	174	176	179	186	186	173
1944	183	183	181	179	176	174	174	176	181	183	186	186	125
1945	186	183	183	179	179	179	179	179	181	186	188	188	180
1946	183	183	186	183	193	200	240	281	286	290	300	300	234
1947	296	291	277	258	237	227	242	258	280	299	320	325	271
1948	322	313	294	277	273	280	289	289	254	310	329	329	297
1949	318	308	280	254	246	246	246	254	273	291	301	299	273
1950	280	265	256	246	273	242	246	265	282	291	299	299	266
1951	287	284	277	275	273	280	271	289	301	313	336	332	291
1952	270	313	303	291	291	291	299	303	318	334	339	334	310
1953	327	313	289	280	275	273	280	287	299	313	306	334	295
1954	291	277	268	249	251	249	251	258	280	282	287	280	268
1955	273	270	256	254	251	263	258	261	275	280	291	287	267
1956	275	275	263	254	261	261	261	265	275	287	287	282	271
1957	275	275	261	251	249	244	256	265	275	287	294	277	267
1958	287	284	263	249	246	232	242	246	277	280	277	275	264
1959	280	277	256	256	249	244	251	258	265	275	273	280	264[1]

---

[1] Simple average of the 12 monthly prices.

Table 43. Milk retail: Relative prices received by Louisiana farmers, by months, 1910-1959

(Crop year 1935-39=100)

Year	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	Weighted avg.
						------------ per cent ------------							
1910	96	94	92	90	88	88	90	92	94	96	96	96	93
1911	96	94	92	90	88	88	90	92	94	96	96	94	92
1912	96	94	92	81	88	88	90	92	94	96	96	96	92
1913	94	92	87	86	84	84	86	90	90	90	97	92	89
1914	92	92	90	88	86	86	86	90	92	94	96	96	91
1915	96	94	94	87	86	88	92	92	92	92	97	96	92
1916	94	94	90	88	86	84	87	90	92	92	94	100	91
1917	100	100	100	102	104	97	102	107	110	117	118	122	107
1918	122	122	120	120	117	117	120	120	122	131	135	139	124
1919	135	131	131	131	131	131	131	135	143	145	153	155	138
1920	165	155	153	153	153	153	158	159	161	173	171	165	160
1921	155	151	149	141	133	133	131	117	120	120	138	131	135
1922	129	128	124	120	114	114	120	122	124	124	128	129	123
1923	129	138	124	122	120	120	120	116	118	120	132	139	125
1924	140	141	143	122	115	116	118	118	126	133	136	130	127
1925	124	123	122	116	116	117	122	122	131	135	137	137	124
1926	137	139	135	129	129	122	133	134	135	135	135	137	131
1927	139	139	139	136	135	135	136	136	137	137	139	139	135
1928	139	139	139	137	136	133	133	133	134	136	139	139	135
1929	140	137	136	136	130	129	129	131	131	131	133	142	131
1930	135	134	133	133	127	133	133	131	129	127	127	126	129
1931	126	119	119	115	115	112	112	112	110	110	110	108	113
1932	103	102	102	102	98	92	87	91	91	91	90	90	94
1933	92	92	92	86	86	84	94	102	102	102	102	102	94
1934	100	98	92	92	94	93	92	96	97	97	101	101	96
1935	101	104	105	103	103	97	96	96	97	97	97	98	99
1936	98	97	97	97	97	100	100	100	100	107	107	107	100
1937	107	105	104	104	104	102	103	103	103	102	103	105	103
1938	105	105	102	98	98	96	97	98	96	96	97	98	98
1939	98	98	98	98	98	99	100	101	102	103	104	104	99
1940	103	103	101	103	102	102	101	101	102	102	104	104	101
1941	104	104	103	103	103	103	104	106	116	116	116	117	107
1942	119	115	116	116	117	119	119	119	121	121	123	126	118
1943	127	129	131	132	127	131	131	131	132	133	133	133	129
1944	133	133	133	133	131	128	133	134	134	135	135	136	131
1945	136	136	136	136	135	135	136	137	138	138	138	139	135
1946	139	139	139	139	139	143	155	156	166	173	179	179	153
1947	177	177	177	176	176	176	177	177	182	187	192	192	180
1948	202	202	202	194	181	192	192	202	195	202	202	202	199
1949	202	197	197	197	192	192	192	195	196	201	207	205	198
1950	205	205	203	198	216	198	198	205	210	210	210	212	204
1951	212	217	217	216	214	210	215	216	218	220	227	227	217
1952	224	230	225	222	222	222	226	227	227	227	232	232	226
1953	232	232	230	229	224	224	224	224	224	224	224	232	226
1954	223	223	223	221	218	222	222	223	225	227	228	228	224
1955	226	226	226	226	226	227	226	232	230	233	238	238	230
1956	232	229	228	228	227	226	229	226	230	230	232	235	229
1957	233	233	232	232	232	232	242	232	232	232	237	232	234
1958	232	232	237	232	228	228	228	232	232	242	242	242	234
1959	242	242	242	242	249	232	232	232	237	232	289	237	237 1/

1/ Simple average of the 12 monthly period.

Table 44. Butter: Relative prices received by Louisiana farmers, by months, 1910-1952

(Crop year 1935-39=100)

Year	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	Weighted avg.
						------------- per cent -------------							
1910	92	96	96	92	92	92	87	89	85	85	92	92	91
1911	92	92	92	89	89	89	85	85	92	92	92	96	90
1912	103	103	99	99	99	92	92	96	96	99	103	106	99
1913	99	99	99	96	99	99	99	99	96	99	99	99	98
1914	99	99	99	99	99	99	99	99	99	99	99	99	99
1915	103	103	99	99	99	99	99	99	99	103	103	106	101
1916	103	99	99	99	99	103	103	103	99	106	113	113	103
1917	117	117	117	121	121	121	121	121	121	128	135	145	124
1918	160	156	142	135	135	135	138	142	149	163	170	184	151
1919	184	170	163	170	181	163	149	156	156	163	184	199	170
1920	191	177	181	177	170	170	170	170	177	184	181	191	178
1921	184	163	156	156	142	128	121	128	135	142	142	142	145
1922	145	135	128	131	128	121	121	121	121	128	135	142	130
1923	142	138	142	142	142	142	135	142	145	149	156	160	145
1924	167	177	163	156	163	149	145	156	160	156	156	170	160
1925	149	142	145	160	160	156	149	145	160	156	166	167	155
1926	152	156	152	149	149	160	145	145	149	149	160	163	152
1927	160	163	152	160	149	152	152	152	160	160	156	167	157
1928	160	156	156	156	156	152	145	149	149	156	152	156	154
1929	145	149	149	152	149	145	149	152	152	152	160	149	150
1930	149	149	149	149	149	145	142	142	138	145	145	135	145
1931	128	121	121	117	113	106	103	99	103	106	103	113	111
1932	103	92	89	89	78	74	74	78	78	78	74	78	82
1933	78	74	71	74	74	78	82	78	78	82	85	85	78
1934	82	85	85	82	82	85	82	85	92	92	96	96	87
1935	99	110	103	103	99	96	96	99	99	99	106	106	101
1936	110	103	103	96	96	96	103	106	103	106	110	113	104
1937	110	103	106	106	106	103	103	103	103	106	110	110	106
1938	106	99	99	99	96	89	89	96	96	99	99	99	97
1939	96	96	92	92	92	92	89	85	92	96	96	96	93
1940	96	96	92	92	96	92	96	96	96	96	96	103	96
1941	103	103	99	99	103	103	110	106	113	113	131	124	108
1942	121	117	117	121	121	121	120	121	128	131	135	149	125
1943	149	156	156	156	156	160	160	160	160	163	170	170	160
1944	167	167	163	163	163	156	156	156	160	160	163	174	162
1945	170	167	167	167	167	167	170	170	170	174	177	177	170
1946	181	181	181	181	181	191	230	230	223	230	252	259	210
1947	241	227	227	223	220	209	213	216	241	241	245	262	230
1948	252	248	238	238	234	227	227	227	234	230	230	234	235
1949	230	223	220	220	216	209	213	213	213	213	220	216	217
1950	214	214	211	207	200	200	200	200	207	214	214	225	209
1951	225	225	218	214	218	214	214	207	214	225	225	225	227
1952	225	225	214	214	214	214	214	214	214	214	214	214	216

Discontinued after 1952.

Table 45. Butterfat: Relative prices received by Louisiana farmers, by months, 1910-1959

(Crop year 1935-39=100)

Year	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	Weighted avg.
						per cent							
1910	117	109	113	109	101	101	101	105	105	109	113	105	107
1911	101	97	89	81	77	81	89	89	93	105	117	126	95
1912	130	117	117	113	105	97	93	97	101	105	113	121	109
1913	121	121	126	113	105	101	97	101	113	113	117	121	112
1914	117	109	101	93	97	97	101	105	109	113	117	117	106
1915	117	113	105	109	101	101	97	89	97	105	113	121	106
1916	113	117	117	109	101	101	101	105	109	117	134	134	113
1917	138	142	146	146	134	130	130	134	142	146	150	162	142
1918	170	166	154	146	150	150	154	166	182	202	227	235	175
1919	223	198	210	219	198	190	190	198	211	239	256	259	216
1920	247	243	239	227	219	198	194	202	211	219	223	235	221
1921	231	178	178	178	150	130	126	121	142	162	162	170	161
1922	170	166	150	158	150	142	142	142	142	154	170	174	155
1923	178	178	182	174	170	154	154	158	162	166	170	178	169
1924	178	170	166	162	158	154	150	154	162	162	162	166	161
1925	162	154	154	154	154	150	146	142	146	150	154	162	153
1926	162	158	154	154	154	154	158	158	154	154	170	194	161
1927	170	154	158	170	154	158	162	154	170	178	186	174	165
1928	190	170	158	162	166	174	166	162	170	162	170	158	165
1929	166	174	178	162	166	166	162	170	166	170	159	158	165
1930	154	154	146	146	154	138	146	142	142	142	130	126	141
1931	113	97	109	101	93	93	93	101	93	97	109	85	97
1932	81	77	69	69	61	57	57	57	57	57	57	57	65
1933	61	61	61	61	61	65	69	65	65	69	65	65	65
1934	61	69	69	69	73	73	73	73	77	89	93	89	77
1935	93	113	101	113	101	97	89	89	89	89	89	97	97
1936	105	105	105	105	89	97	117	121	117	109	113	109	109
1937	126	121	121	113	109	113	113	113	113	121	126	126	117
1938	109	109	109	97	85	89	89	89	85	85	85	89	93
1939	85	85	85	81	85	85	81	81	85	85	93	97	85
1940	105	105	97	97	97	97	97	97	101	101	101	109	101
1941	105	105	105	105	121	121	121	121	126	126	134	138	121
1942	134	130	130	130	134	134	134	134	138	142	146	162	137
1943	166	166	162	162	162	158	159	166	166	174	182	182	165
1944	182	182	182	182	178	174	174	174	182	182	190	190	181
1945	190	190	190	186	186	186	190	190	190	194	194	194	190
1946	190	190	190	190	190	190	223	223	231	263	287	296	218
1947	262	246	246	246	238	226	226	246	274	274	278	290	250
1948	290	278	270	270	266	258	258	266	234	262	262	266	236
1949	262	254	242	242	238	238	234	234	234	234	242	238	218
1950	234	234	230	226	242	226	222	222	230	238	238	286	230
1951	246	250	246	242	246	242	242	238	242	242	254	250	218
1952	254	258	242	242	242	242	250	250	254	254	254	250	210
1953	250	242	242	234	234	230	234	234	234	242	242	250	238
1954	242	242	234	214	214	201	214	214	218	218	226	218	214
1955	218	210	210	206	206	206	201	201	201	201	201	201	210
1956	206	206	206	206	206	202	202	206	206	210	214	214	206
1957	210	210	206	206	206	202	206	206	206	210	210	214	206
1958	214	214	214	210	210	206	210	210	202	202	202	202	208
1959	202	202	202	202	202	202	202	202	202	202	206	206	202 1/

1/ Simple average of the 12 monthly prices.

Table 46. Wool: Relative prices received by Louisiana farmers, by months, 1910-1959

(Crop year 1935-39=100)

Year	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	Weighted avg.
						per cent							
1910	100	104	96	87	109	96	100	91	70	83	78	74	96
1911	61	78	74	78	74	61	61	65	74	65	65	65	70
1912	65	65	70	61	65	74	70	70	78	70	65	57	70
1913	70	65	57	65	56	52	65	65	65	65	57	61	61
1914	65	61	61	61	43	69	70	65	74	78	61	61	61
1915	70	61	65	70	61	70	65	74	57	74	61	70	65
1916	74	78	61	69	100	109	87	96	87	78	78	78	91
1917	74	83	96	117	130	165	195	187	187	157	152	183	152
1918	165	183	161	170	191	191	209	200	204	217	217	200	191
1919	191	174	170	165	161	157	161	152	165	170	174	152	161
1920	148	148	148	148	143	109	91	83	78	57	43	43	122
1921	43	43	48	65	43	52	43	43	48	61	48	48	52
1922	57	52	48	52	70	69	65	65	61	78	70	78	65
1923	100	78	78	83	87	91	96	104	109	122	135	148	87
1924	130	130	130	130	122	122	113	143	148	143	152	157	122
1925	161	165	170	174	174	174	161	152	152	152	152	157	170
1926	165	157	143	130	109	109	117	122	130	130	148	122	117
1927	130	135	130	113	113	113	122	122	130	135	130	126	113
1928	126	135	135	130	139	148	161	161	152	152	148	148	143
1929	148	135	148	148	143	135	126	135	143	139	130	139	139
1930	143	143	122	126	104	87	87	100	91	96	96	87	100
1931	83	78	74	74	65	61	52	52	48	52	57	48	57
1932	43	39	52	39	30	26	26	30	43	43	39	39	30
1933	39	35	35	35	48	78	87	83	83	83	87	87	70
1934	91	96	96	91	91	87	91	87	91	83	91	96	91
1935	87	87	83	74	74	83	96	91	91	91	100	100	87
1936	96	91	91	91	96	104	100	100	104	109	113	113	100
1937	122	122	122	126	135	135	135	152	143	126	126	122	130
1938	117	113	100	91	96	83	83	83	83	87	91	91	87
1939	91	91	91	87	87	96	96	91	104	104	100	100	91
1940	109	104	104	91	109	109	117	117	113	122	126	126	104
1941	122	126	126	139	148	157	157	139	143	148	148	148	148
1942	148	148	148	148	165	165	174	174	174	174	174	174	165
1943	174	174	174	174	183	196	183	183	178	178	178	178	183
1944	187	183	183	183	187	191	200	209	217	209	200	191	209
1945	178	178	183	182	182	182	183	191	200	208	213	200	209
1946	200	208	208	208	208	204	208	208	208	204	204	204	209
1947	196	187	187	187	187	183	187	183	183	196	196	200	187
1948	191	196	196	196	196	200	200	200	183	196	196	196	196
1949	196	204	196	196	187	191	191	187	191	191	196	187	196
1950	187	191	191	200	291	230	239	248	252	261	265	265	239
1951	283	283	326	348	348	391	239	348	326	326	217	313	454
1952	313	283	261	261	239	239	230	222	217	226	217	217	226
1953	217	217	222	217	217	217	248	222	222	222	222	217	248
1954	222	222	222	222	239	222	254	226	226	226	226	226	243
1955	226	209	191	174	161	183	200	165	187	187	178	178	196
1956	161	161	143	152	165	139	174	135	183	191	209	178	169
1957	183	183	209	209	213	196	230	204	217	161	209	187	222
1958	174	200	174	143	130	130	130	130	135	143	188	139	161
1959	178	130	130	139	139	157	183	183	170	165	165	165	157[1]

---

[1] Simple average of the 12 monthly prices.

Table 47. Cotton: Relative prices received by Louisiana farmers, by months, 1910-1959

(Crop year 1935-39=100)

Year	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	Weighted avg.
						per cent							
1910	137	135	133	131	133	132	131	132	130	130	135	137	142
1911	136	134	132	131	134	137	131	123	105	93	86	82	97
1912	82	88	92	100	107	109	112	110	106	103	104	114	115
1913	116	110	110	112	112	112	112	112	118	126	118	112	124
1914	111	110	110	112	112	116	118	106	86	68	63	65	77
1915	67	70	73	80	82	78	77	78	90	104	107	107	111
1916	109	109	108	109	112	116	118	128	139	151	171	170	170
1917	160	155	158	172	185	213	230	226	223	232	250	263	267
1918	278	286	295	288	267	267	270	282	296	285	269	264	289
1919	255	239	230	232	262	291	302	296	293	321	337	352	362
1920	361	356	366	374	374	371	366	324	257	202	154	124	170
1921	116	112	97	90	91	90	88	95	138	170	154	145	161
1922	145	141	145	145	155	181	192	193	187	192	217	227	228
1923	234	251	267	265	245	236	229	221	240	260	276	305	280
1924	305	295	257	276	270	257	255	257	210	210	200	207	223
1925	208	212	220	214	210	219	219	214	207	198	172	166	195
1926	168	152	151	152	150	153	144	146	158	107	101	97	126
1927	98	114	118	123	135	142	146	161	216	193	185	174	202
1928	174	162	166	172	187	184	193	179	164	170	168	170	180
1929	170	169	178	172	169	166	165	163	170	163	154	153	168
1930	152	142	130	135	135	130	111	107	93	86	89	83	94
1931	82	85	88	88	82	71	81	57	54	48	57	52	56
1932	53	53	60	54	49	43	48	60	70	64	57	52	68
1933	54	53	59	59	77	82	98	83	85	86	90	90	104
1934	93	110	112	110	105	110	116	124	126	119	118	118	126
1935	116	114	110	110	115	110	111	108	100	105	109	106	110
1936	105	105	105	107	108	108	117	117	120	117	117	119	126
1937	118	118	127	131	122	114	116	102	85	76	71	72	85
1938	73	77	79	79	80	75	78	77	79	81	80	79	87
1939	79	78	79	75	80	80	82	82	87	82	84	91	91
1940	94	93	93	92	92	89	90	88	88	90	90	88	98
1941	90	90	94	100	109	118	133	142	166	159	153	158	174
1942	173	175	176	187	183	175	177	171	176	176	176	176	190
1943	184	184	186	190	190	190	190	191	192	188	180	175	198
1944	178	184	188	190	190	190	196	194	199	200	198	195	210
1945	197	196	195	198	202	205	205	206	208	215	215	215	229
1946	220	222	231	237	245	252	287	318	336	352	286	295	336
1947	334	320	337	337	340	351	367	351	325	316	322	346	328
1948	349	327	337	354	354	358	344	370	306	316	311	313	316
1949	316	304	291	306	316	314	314	306	311	299	276	270	297
1950	385	290	302	306	309	324	338	374	415	400	404	418	407
1951	417	433	435	440	434	427	403	283	349	356	400	407	376
1952	404	402	391	405	385	405	393	399	404	371	357	340	370
1953	326	332	336	321	334	331	334	336	338	336	332	340	335
1954	328	331	337	334	337	337	340	348	357	350	332	324	343
1955	329	334	334	334	344	339	344	344	344	329	321	339	331
1956	322	330	335	334	339	337	329	337	332	327	314	314	324
1957	324	324	319	324	334	334	335	338	343	321	316	285	310
1958	279	280	308	308	304	304	304	344	354	304	304	309	324
1959	304	314	319	319	329	329	329	329	339	337	332	331	335

Table 48. Oil bearing crops: Index numbers of prices received by Louisiana farmers, by months, 1910-1959

(Crop year 1935-39=100)

Year	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	Weighted avg.
						per cent							
1910	90	90	93	96	98	100	98	89	89	91	85	86	104
1911	90	84	84	84	78	70	73	83	62	59	65	64	74
1912	59	63	63	62	67	59	63	67	62	63	69	68	76
1913	70	75	74	75	78	68	64	69	68	66	62	64	76
1914	61	62	63	69	76	62	69	72	46	56	47	61	62
1915	66	71	71	70	73	68	66	59	73	106	118	119	111
1916	121	138	120	140	112	121	126	126	126	155	196	196	173
1917	172	156	182	190	201	200	187	207	184	215	228	226	247
1918	228	232	237	238	245	236	224	196	231	231	220	210	262
1919	210	210	214	217	217	215	214	217	207	217	240	236	262
1920	228	224	245	258	244	230	224	191	120	96	96	74	119
1921	71	67	66	65	60	62	60	74	92	97	100	85	112
1922	88	89	88	113	116	115	103	86	93	96	120	147	115
1923	131	121	121	133	134	124	131	138	138	138	145	141	164
1924	138	135	155	148	143	138	138	121	107	103	105	110	135
1925	121	116	117	116	123	110	138	111	115	102	85	79	135
1926	86	96	97	95	94	101	113	97	87	63	61	60	96
1927	63	77	79	84	83	83	86	87	116	119	118	124	137
1928	126	121	121	124	135	135	134	128	104	110	121	121	135
1929	121	121	128	124	121	117	114	100	100	107	104	107	128
1930	107	104	107	107	107	100	93	79	79	66	66	66	95
1931	69	69	73	73	73	66	67	46	28	23	30	31	40
1932	33	32	34	33	32	29	29	29	37	35	32	31	46
1933	31	31	32	35	41	41	48	48	41	44	45	45	58
1934	54	55	61	62	66	64	66	86	114	117	124	124	132
1935	131	131	131	124	127	124	124	100	100	114	117	117	123
1936	117	117	117	121	117	114	114	114	117	117	117	121	136
1937	124	128	128	132	132	121	118	84	63	60	63	63	80
1938	59	66	69	69	100	73	73	73	69	76	76	79	84
1939	79	79	77	79	78	80	71	47	70	77	76	79	77
1940	83	85	87	88	88	84	83	76	68	71	76	79	85
1941	84	83	86	91	97	100	117	122	161	177	167	165	173
1942	164	165	168	169	169	159	159	155	151	154	151	151	163
1943	154	154	158	160	162	163	160	175	178	178	175	168	199
1944	172	173	177	177	177	180	183	176	176	169	172	172	196
1945	176	176	176	180	180	184	183	176	169	172	176	179	192
1946	179	176	176	180	179	183	197	200	199	216	311	318	233
1947	320	313	326	343	308	279	276	259	283	306	354	320	291
1948	336	330	333	349	347	339	338	258	175	224	254	245	240
1949	238	208	222	222	211	204	182	175	166	154	142	143	163
1950	160	168	177	185	184	195	197	229	287	265	299	306	272
1951	311	335	331	336	321	318	280	233	233	227	247	243	233
1952	241	253	243	241	239	244	242	242	246	249	250	251	245
1953	247	242	246	245	245	241	233	212	189	195	200	251	198
1954	205	216	220	228	233	220	220	201	225	217	211	217	205
1955	218	226	232	229	229	188	212	157	159	160	150	150	162
1956	168	161	173	183	188	186	183	174	182	196	204	210	187
1957	203	203	142	145	139	139	136	181	190	170	169	171	175
1958	168	171	184	142	148	139	127	181	163	145	144	161	152
1959	167	168	165	130	130	130	124	162	138	146	148	147	145

Table 49. Cottonseed: Relative prices received by Louisiana farmers, by months, 1910-1959

(Crop year 1935-39=100)

Year	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	Weighted avg.
						per cent							
1910	90	90	93	97	98	100	98	89	89	91	86	86	104
1911	90	84	84	84	78	70	73	83	62	59	65	64	73
1912	59	63	63	62	67	59	63	67	62	63	69	68	77
1913	70	75	74	75	78	68	64	69	68	66	62	64	76
1914	61	62	63	69	76	62	69	72	46	56	47	61	62
1915	66	71	71	70	73	68	66	59	73	106	118	119	111
1916	121	138	120	140	112	121	126	126	126	155	197	197	174
1917	172	156	182	191	201	200	187	207	184	216	229	227	248
1918	228	232	237	238	245	236	224	197	231	231	221	210	264
1919	210	210	214	217	217	215	214	217	207	217	240	237	263
1920	228	224	245	259	244	230	224	191	120	96	96	74	118
1921	70	67	66	64	59	62	60	74	92	97	100	85	112
1922	88	89	88	113	116	115	103	86	93	96	120	147	115
1923	131	121	121	133	134	124	131	138	138	138	145	141	164
1924	138	134	155	148	143	138	138	121	107	103	105	110	127
1925	121	116	117	116	122	110	138	111	114	102	84	79	125
1926	86	96	97	95	93	101	113	97	86	63	61	60	87
1927	62	77	79	84	83	83	86	87	116	119	118	124	133
1928	126	121	121	124	134	134	134	128	103	110	121	121	129
1929	121	121	128	124	121	117	114	100	100	107	103	107	121
1930	107	103	107	107	107	100	93	79	79	66	66	66	87
1931	69	69	72	72	72	66	67	47	28	22	30	31	31
1932	32	32	34	33	32	29	29	29	37	35	32	31	41
1933	31	31	32	34	40	41	48	48	40	44	44	45	50
1934	53	55	61	62	66	64	66	86	114	117	124	124	129
1935	131	131	131	124	128	124	124	100	100	114	117	117	124
1936	117	117	117	121	117	114	114	114	117	117	117	121	138
1937	124	128	128	131	131	121	117	83	62	59	62	62	77
1938	59	66	69	69	100	72	72	72	69	76	77	79	84
1939	79	79	77	79	78	79	71	46	70	77	77	80	78
1940	83	85	87	88	88	84	83	76	68	71	76	79	83
1941	84	83	86	90	96	100	118	123	162	179	169	166	194
1942	165	166	168	170	169	159	159	155	152	155	152	152	181
1943	155	155	159	160	162	163	160	176	179	179	176	169	210
1944	172	172	176	176	176	179	183	176	176	169	172	172	204
1945	176	176	176	179	179	183	183	176	169	172	176	179	203
1946	179	176	176	179	179	183	197	200	200	217	314	321	252
1947	371	363	371	367	342	301	301	281	310	363	354	363	325
1948	375	367	363	371	375	367	375	289	183	252	269	281	272
1949	269	224	224	224	224	204	183	183	183	167	147	145	171
1950	155	163	171	175	173	185	196	244	330	322	363	367	323
1951	371	399	387	387	371	367	318	257	265	257	281	273	261
1952	281	285	269	269	261	265	265	265	273	281	285	285	275
1953	281	273	273	269	269	265	257	232	208	216	220	285	215
1954	224	232	232	232	240	224	224	208	252	244	232	240	242
1955	236	244	248	244	244	191	232	1/	171	171	175	175	175
1956	183	183	183	191	191	191	196	187	204	224	232	240	209
1957	228	228	1/	-	-	-	-	204	216	187	187	187	194
1958	183	187	204	-	-	-	-	200	179	155	155	179	165
1959	187	187	183	-	-	-	-	179	147	159	159	159	156

1/ Not quoted.

Table 50. Soybeans: Relative prices received by Louisiana farmers, by months, 1937-1959

(Crop year 1935-39=100)

Year	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	Weighted avg.
						per cent							
1937	131	128	128	159	162	156	144	119	112	100	94	88	87
1938	81	81	84	84	91	94	94	88	88	78	72	72	84
1939	78	78	84	84	100	94	84	78	78	72	56	62	73
1940	66	78	78	84	94	97	88	72	69	66	59	75	90
1941	84	91	97	97	94	97	100	94	100	94	97	103	122
1942	119	128	144	156	156	156	156	144	125	122	109	109	117
1943	116	125	138	144	150	147	128	131	131	122	122	128	173
1944	144	188	212	225	225	219	175	175	162	150	150	156	175
1945	181	181	203	219	219	219	203	203	188	166	159	159	164
1946	159	163	181	194	181	197	197	184	175	156	188	188	186
1947	194	191	216	284	222	222	213	204	216	185	194	216	206
1948	241	241	250	296	278	272	247	179	154	154	216	154	163
1949	160	170	216	210	201	204	179	154	123	123	130	139	143
1950	173	179	191	210	210	219	201	191	179	123	142	157	145
1951	164	176	191	210	198	198	185	173	154	154	164	161	164
1952	173	173	179	173	185	191	185	185	179	161	164	167	170
1953	164	167	179	185	185	182	173	160	142	144	151	167	154
1954	157	176	191	216	216	201	201	185	157	148	157	160	158
1955	173	182	191	191	191	179	164	157	121	133	120	120	230
1956	121	136	148	164	179	173	154	142	130	127	133	136	133
1957	142	142	142	145	139	139	136	127	127	127	124	130	127
1958	121	130	136	142	148	139	127	136	124	120	117	117	119
1959	117	120	120	130	130	130	124	120	117	114	120	117	120

Table 51. Soybeans: Mid-month prices per bushel received by Louisiana farmers, 1937-1959

Year	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	Weighted avg.
					dollars per bushel								
1937	2.10	2.05	2.05	2.55	2.60	2.50	2.30	1.90	1.80	1.60	1.50	1.40	1.41
1938	1.30	1.30	1.35	1.35	1.45	1.50	1.50	1.40	1.40	1.25	1.15	1.15	1.36
1939	1.25	1.25	1.35	1.35	1.60	1.50	1.35	1.25	1.25	1.15	.90	1.00	1.18
1940	1.05	1.25	1.25	1.35	1.50	1.55	1.40	1.15	1.10	1.05	.95	1.20	1.46
1941	1.35	1.45	1.55	1.55	1.50	1.55	1.60	1.50	1.60	1.50	1.55	1.65	1.97
1942	1.90	2.05	2.30	2.50	2.50	2.50	2.50	2.30	2.00	1.95	1.75	1.75	1.89
1943	1.85	2.00	2.20	2.30	2.40	2.35	2.05	2.10	2.10	1.95	1.95	2.05	2.80
1944	2.30	3.00	3.40	3.60	3.60	3.50	2.80	2.80	2.60	2.40	2.40	2.50	2.83
1945	2.90	2.90	3.25	3.50	3.50	3.50	3.25	3.25	3.00	2.65	2.55	2.55	2.65
1946	2.55	2.60	2.90	3.10	2.90	3.15	3.15	2.95	2.80	2.50	3.00	3.00	3.01
1947	3.15	3.10	3.50	4.60	3.60	3.60	3.45	3.30	3.50	3.00	3.15	3.50	3.33
1948	3.90	3.90	4.20	4.80	4.50	4.40	4.00	2.90	2.50	2.50	3.50	2.50	2.64
1949	2.60	2.75	3.50	3.50	3.40	3.30	2.90	2.50	2.00	2.00	2.10	2.25	2.31
1950	2.80	2.90	3.10	3.40	3.40	3.55	3.25	3.10	2.90	2.00	2.30	2.55	2.35
1951	2.65	2.85	3.10	3.40	3.20	3.20	3.00	2.80	2.50	2.50	2.65	2.75	2.65
1952	2.80	2.80	2.90	2.80	3.00	3.10	3.00	3.00	2.90	2.75	2.65	2.70	2.75
1953	2.65	2.70	2.90	3.00	3.00	2.95	2.80	2.60	2.30	2.33	2.45	2.70	2.50
1954	2.55	2.85	3.10	3.50	3.50	3.40	3.40	3.00	2.55	2.40	2.55	2.60	2.58
1955	2.80	2.95	3.10	3.10	3.10	2.90	2.65	2.55	2.10	2.15	1.95	1.95	2.09
1956	2.10	2.20	2.40	2.65	2.90	2.80	2.50	2.30	2.10	2.05	2.15	2.20	2.15
1957	2.30	2.30	2.30	2.35	2.25	2.25	2.20	2.05	2.05	2.05	2.00	2.10	2.05
1958	2.10	2.10	2.20	2.30	2.40	2.25	2.05	2.20	2.00	1.95	1.90	1.90	1.93
1959	1.90	1.95	1.95	2.10	2.10	2.10	2.00	1.95	1.90	1.85	1.95	1.90	1.95

Table 52. Rice: Relative prices received by Louisiana farmers, by months, 1910-1959

(Crop year 1935-39=100)

Year	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	Weight avg.
						per cent							
1910	108	96	88	103	100	90	94	99	81	81	84	87	88
1911	88	82	87	77	83	79	96	99	88	94	97	94	105
1912	103	117	125	130	134	125	151	125	119	94	113	119	120
1913	125	127	123	104	108	114	121	131	119	112	140	96	118
1914	109	95	78	92	110	109	119	152	136	94	96	119	121
1915	112	126	129	131	126	126	119	113	100	94	112	99	110
1916	97	118	126	129	96	118	109	138	108	112	122	117	129
1917	117	125	130	175	223	194	226	234	230	210	242	249	256
1918	255	269	294	271	301	278	251	253	245	219	214	219	234
1919	199	234	239	216	260	304	349	462	336	296	300	296	337
1920	373	361	373	340	314	350	274	223	205	166	166	130	153
1921	105	103	106	99	109	101	97	125	127	126	114	114	130
1922	144	126	140	118	113	129	140	136	105	109	140	126	129
1923	126	121	142	143	114	140	157	134	140	144	139	138	148
1924	143	144	140	145	169	175	178	171	168	166	170	183	179
1925	187	183	181	179	184	194	195	190	186	187	197	199	202
1926	200	195	186	170	178	183	190	151	153	145	144	143	151
1927	144	140	142	136	135	132	135	117	118	122	118	119	124
1928	121	116	117	119	125	127	121	119	119	118	122	123	127
1929	127	125	125	126	121	122	122	130	129	127	129	127	135
1930	130	139	134	139	138	135	129	114	103	100	99	95	104
1931	97	101	99	100	96	96	95	73	61	61	78	77	71
1932	73	69	68	64	64	62	60	61	61	55	53	53	59
1933	49	47	52	61	73	78	79	84	97	101	104	97	105
1934	101	103	104	105	101	100	97	103	101	108	110	101	111
1935	100	106	110	112	113	117	114	96	71	84	91	96	96
1936	108	110	108	109	116	116	117	118	129	113	109	106	122
1937	119	126	127	130	123	116	110	99	84	104	108	88	93
1938	94	86	82	74	75	82	83	83	78	84	90	84	88
1939	86	90	84	83	83	83	82	75	116	99	101	96	100
1940	97	90	84	84	97	97	103	103	83	91	104	108	115
1941	125	138	136	162	162	157	152	138	113	125	166	194	180
1942	205	216	231	236	236	223	221	208	208	191	201	221	220
1943	234	234	236	243	239	239	234	210	209	226	249	247	245
1944	252	255	247	248	234	226	225	214	209	238	240	244	243
1945	240	240	240	240	240	240	240	214	216	231	247	240	248
1946	240	234	253	253	260	260	260	227	256	306	322	325	313
1947	350	366	366	354	354	332	378	381	314	329	366	382	349
1948	402	433	415	421	415	427	421	338	268	290	323	329	297
1949	312	288	278	287	278	278	257	271	218	230	264	293	266
1950	293	284	277	274	265	259	280	299	280	317	338	332	309
1951	354	378	372	372	366	348	335	296	244	284	296	296	277
1952	296	281	296	305	317	335	335	329	329	351	372	384	337
1953	396	408	427	427	427	408	354	305	293	335	335	384	305
1954	329	323	311	280	268	235	232	226	241	284	280	284	262
1955	274	271	284	262	268	265	244	244	274	287	274	274	280
1956	262	262	268	262	265	265	256	265	284	290	284	281	293
1957	308	308	308	302	311	317	323	308	314	326	323	311	322
1958	317	323	323	335	320	323	305	302	302	302	296	296	302
1959	311	305	305	311	302	311	302	274	277	284	284	293	284

Table 53. Cowpeas: Relative prices received by Louisiana farmers, by months, 1915-1952

(Crop year 1935-39=100)

Year	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	Weighted avg.
						per cent							
1915	-	115	114	121	112	109	103	109	88	126	89	82	110
1916	95	75	91	96	91	81	71	82	84	79	100	109	88
1917	109	129	129	141	165	194	155	147	150	118	144	153	144
1918	159	171	182	174	165	153	162	174	126	147	147	162	160
1919	147	159	168	171	188	235	247	229	176	194	188	171	189
1920	218	212	218	259	306	312	218	271	212	202	154	154	228
1921	151	151	142	151	147	164	169	169	141	135	131	134	148
1922	126	129	142	148	144	121	125	124	122	133	134	141	132
1923	144	138	131	141	152	154	162	176	163	142	130	135	147
1924	141	147	162	176	182	188	176	176	194	182	147	176	171
1925	176	194	206	235	247	329	153	206	212	191	194	182	216
1926	165	169	215	232	218	229	200	229	165	176	182	162	165
1927	153	159	147	165	147	147	156	144	156	132	141	118	147
1928	135	141	138	144	150	150	156	144	138	132	126	147	164
1929	144	147	150	165	176	194	182	165	129	144	147	132	172
1930	150	159	171	176	182	188	194	171	162	144	153	132	148
1931	126	121	135	144	144	141	150	129	94	88	97	94	122
1932	94	79	85	78	65	68	53	65	65	76	76	62	70
1933	59	59	62	62	68	74	79	88	76	71	68	65	69
1934	79	94	97	112	109	103	103	91	103	97	100	100	99
1935	100	109	118	126	121	124	109	100	85	85	85	79	107
1936	94	91	106	103	118	126	132	118	103	88	88	100	121
1937	112	115	118	124	132	132	121	115	100	88	88	94	100
1938	94	91	94	97	103	103	100	76	85	82	74	79	90
1939	76	85	88	91	94	97	88	88	82	74	59	74	82
1940	71	76	79	79	91	94	97	85	82	76	76	76	90
1941	79	85	88	88	88	91	91	91	85	88	88	94	124
1942	100	106	115	121	126	141	132	129	124	115	109	109	150
1943	121	135	144	147	162	168	153	159	153	153	153	150	200
1944	153	174	182	206	226	203	194	188	171	165	162	165	204
1945	168	179	188	206	212	200	206	200	176	171	176	176	210
1946	176	176	194	212	235	247	247	253	212	203	215	206	262
1947	221	206	241	271	271	282	259	215	203	203	191	191	291
1948	206	229	294	306	294	294	282	218	206	191	206	221	263
1949	235	241	250	265	265	259	247	200	194	206	182	200	216
1950	220	226	213	207	232	238	210	213	213	213	213	226	264
1951	226	250	284	268	268	268	262	243	223	244	238	244	285
1952	262	274	274	305	290	290	290	244	244	1/			

1/ Discontinued after 1952.

Table 54. Feed grains and hay: Index numbers of prices received by Louisiana farmers, by months, 1910-1959

(Crop year 1935-39=100)

Year	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	Weighted avg.
					------------ per cent ------------								
1910	98	101	102	105	106	108	106	101	94	87	83	83	101
1911	84	87	89	92	92	92	97	99	95	94	98	98	119
1912	101	104	109	116	125	126	122	116	102	94	94	100	114
1913	102	101	105	107	107	109	109	112	110	110	109	105	121
1914	105	107	109	109	113	117	118	115	115	113	105	110	127
1915	113	114	119	125	127	132	130	119	111	98	90	92	114
1916	95	98	105	108	105	103	104	108	109	109	115	127	147
1917	130	133	143	162	185	199	215	220	205	191	186	187	212
1918	192	203	224	232	226	222	221	232	228	216	212	212	236
1919	214	218	215	224	237	234	236	236	220	212	207	209	241
1920	214	224	242	254	256	253	248	224	192	160	131	127	170
1921	136	142	131	124	129	130	128	120	108	97	95	99	116
1922	94	99	109	109	107	113	119	115	112	110	112	117	136
1923	120	125	138	145	146	149	147	139	134	136	139	139	152
1924	142	143	154	148	144	144	149	161	162	168	164	157	173
1925	161	171	179	160	179	172	165	142	144	136	135	139	154
1926	157	144	141	148	146	140	143	132	132	126	123	114	137
1927	116	122	114	120	123	125	140	135	127	120	119	125	141
1928	130	133	136	136	141	150	152	141	140	122	124	124	142
1929	121	122	132	139	132	133	137	131	126	122	122	123	137
1930	121	126	127	130	128	128	122	124	128	127	119	116	126
1931	116	115	118	113	108	109	103	89	75	60	60	62	72
1932	62	61	64	60	60	62	62	60	58	57	55	56	66
1933	51	53	55	61	72	71	84	85	76	74	75	76	89
1934	79	83	87	88	89	94	95	98	104	104	107	116	124
1935	116	123	126	128	125	120	118	110	97	89	89	87	101
1936	86	89	96	95	98	94	102	119	125	117	112	119	127
1937	123	122	126	134	134	128	130	115	102	90	83	82	99
1938	86	87	88	88	90	88	88	82	76	71	69	70	80
1939	71	71	76	80	79	83	84	77	81	79	81	82	97
1940	86	92	96	94	99	96	94	91	83	81	82	81	97
1941	83	87	89	96	97	97	96	94	98	97	98	99	116
1942	103	110	116	123	124	121	122	118	117	115	118	123	138
1943	125	135	143	148	151	151	158	156	158	166	169	176	201
1944	180	184	189	186	180	183	182	177	180	176	177	179	207
1945	183	184	183	184	181	175	175	178	170	166	167	173	202
1946	169	176	182	182	194	204	239	231	215	217	220	220	252
1947	233	236	243	243	241	240	247	260	281	278	282	285	293
1948	291	283	296	293	288	279	289	276	253	249	206	240	238
1949	241	228	233	234	230	217	207	200	200	213	193	200	202
1950	203	199	197	203	214	200	209	209	212	206	214	220	220
1951	224	239	239	235	237	238	236	225	224	233	244	256	250
1952	274	272	269	269	264	256	251	258	262	261	274	271	265
1953	271	269	265	257	257	237	239	231	226	220	229	271	228
1954	238	235	239	230	238	227	215	217	215	216	218	215	213
1955	211	220	218	212	215	177	201	199	176	172	165	165	171
1956	167	172	174	168	177	176	172	171	178	183	187	195	189
1957	207	207	207	204	199	189	196	191	195	190	200	198	195
1958	198	202	209	205	203	194	198	196	191	183	177	182	183
1959	184	188	192	193	188	193	191	184	180	175	178	182	182

Table 55. Corn: Relative prices received by Louisiana farmers, by months, 1910-1959

(Crop year 1935-39=100)

Year	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	Weighted avg.
						per cent							
1910	95	96	96	100	104	106	104	96	88	82	75	75	89
1911	77	78	81	86	86	86	90	91	88	88	91	91	109
1912	92	94	97	105	119	119	119	114	96	88	88	91	104
1913	94	94	100	103	104	106	106	109	106	106	104	100	117
1914	99	100	101	103	109	116	117	112	112	109	99	106	124
1915	112	112	117	122	123	130	127	117	109	92	83	86	103
1916	88	94	101	103	100	99	101	106	108	106	114	128	161
1917	131	132	145	169	192	209	231	239	221	200	192	195	231
1918	196	205	230	238	229	226	230	244	238	221	213	212	246
1919	214	217	210	218	234	234	239	239	226	217	204	205	247
1920	208	218	244	257	258	258	252	226	192	153	119	117	141
1921	125	130	119	114	125	127	125	114	99	86	83	88	103
1922	86	91	104	104	101	106	114	110	106	105	106	110	134
1923	114	121	135	143	143	147	145	138	134	135	136	136	156
1924	140	142	156	149	143	143	149	158	161	166	164	148	174
1925	151	162	169	156	182	171	161	143	143	130	132	127	144
1926	130	130	130	138	132	130	135	117	123	119	116	104	129
1927	110	116	109	114	118	123	142	136	130	117	116	122	141
1928	125	127	132	132	139	151	153	143	143	121	123	121	140
1929	118	118	129	140	131	134	138	132	125	119	119	119	136
1930	118	123	123	130	129	127	122	125	129	127	118	116	127
1931	116	113	116	113	108	109	106	90	73	53	55	57	63
1932	57	56	58	56	56	60	60	57	53	53	49	51	63
1933	47	48	51	58	71	70	86	84	74	73	74	75	90
1934	77	84	87	90	92	96	97	100	105	104	108	119	130
1935	118	125	127	132	130	126	123	114	99	91	87	86	101
1936	84	88	94	96	96	96	105	122	129	121	116	122	137
1937	125	125	130	142	140	134	136	121	103	87	78	78	94
1938	82	82	84	90	87	87	86	81	73	65	64	64	74
1939	66	66	70	75	77	83	83	77	78	78	78	79	91
1940	83	87	92	92	97	96	95	95	83	79	81	78	93
1941	82	86	88	96	96	96	97	97	100	97	99	99	119
1942	104	110	117	125	127	125	127	123	121	117	119	123	141
1943	125	134	142	148	155	156	161	157	160	168	168	177	193
1944	178	182	188	184	183	188	187	179	182	179	177	179	199
1945	183	184	184	188	184	178	178	182	175	169	169	174	199
1946	169	177	186	186	201	214	256	245	223	227	227	227	256
1947	250	256	263	263	267	271	279	301	320	307	309	313	314
1948	320	314	320	321	321	314	314	290	267	249	179	226	226
1949	229	213	214	221	221	211	200	191	187	207	179	186	186
1950	186	186	187	193	193	193	206	206	206	194	194	199	209
1951	207	221	214	221	231	231	229	207	207	214	214	236	236
1952	253	253	253	264	259	257	250	250	250	256	257	257	256
1953	257	261	264	257	257	243	243	243	224	213	217	257	223
1954	224	231	236	236	240	236	221	216	207	207	206	200	204
1955	203	207	207	201	206	166	200	193	164	151	146	144	151
1956	144	149	154	156	166	169	168	164	164	164	167	174	177
1957	187	187	191	190	191	187	190	184	184	176	186	183	186
1958	183	187	193	193	194	189	193	191	176	170	161	163	170
1959	167	170	179	181	181	186	184	173	167	161	160	164	167

Table 56. Oats: Relative prices received by Louisiana farmers, by months, 1910-1959

(Crop year 1935-39=100)

Year	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	Weighted avg.
						per cent							
1910	120	120	126	120	116	118	118	108	104	100	100	100	122
1911	104	110	112	108	120	120	120	124	122	126	130	120	135
1912	122	128	128	136	134	130	124	116	108	104	104	104	128
1913	108	108	108	108	108	110	112	112	112	112	112	112	122
1914	116	122	120	115	116	112	116	120	128	132	128	132	135
1915	136	136	140	148	148	144	140	124	108	112	112	112	139
1916	112	116	120	120	120	116	114	116	110	112	126	136	133
1917	142	144	148	154	160	164	172	192	182	178	192	184	196
1918	168	174	202	220	220	212	216	224	216	206	202	194	228
1919	192	188	184	196	200	208	212	204	186	178	194	192	228
1920	208	240	240	232	236	238	248	235	204	212	192	156	237
1921	176	182	152	142	124	110	118	124	140	148	140	136	135
1922	124	128	130	124	112	108	116	124	128	124	128	128	133
1923	130	132	132	146	144	140	132	126	128	134	138	126	143
1924	132	132	130	122	130	130	134	120	136	140	156	162	152
1925	168	170	170	140	136	150	152	122	128	140	150	160	150
1926	130	118	126	122	120	112	120	120	122	128	140	130	133
1927	120	130	130	120	120	126	120	124	130	124	136	130	139
1928	128	134	142	154	160	162	154	138	124	128	134	130	157
1929	126	136	134	128	130	140	136	138	140	142	136	134	148
1930	138	136	130	128	130	128	112	116	114	110	108	112	124
1931	108	104	112	94	102	90	78	66	72	62	66	68	80
1932	64	64	66	64	66	62	62	60	60	54	52	56	65
1933	56	56	60	64	68	74	96	94	92	84	90	84	98
1934	88	90	100	96	96	102	96	116	116	136	146	130	135
1935	130	128	126	130	128	118	112	108	100	92	92	88	107
1936	84	92	90	80	90	70	86	102	108	100	112	114	117
1937	120	120	128	128	132	108	116	102	98	98	94	90	111
1938	86	84	84	84	82	76	76	68	74	74	76	74	80
1939	80	80	82	80	76	78	72	70	92	90	90	90	87
1940	92	100	100	100	100	86	80	80	80	84	86	86	91
1941	86	86	86	90	88	80	82	82	90	104	108	112	102
1942	112	114	120	120	120	125	110	110	112	120	120	130	126
1943	132	142	152	156	160	152	162	170	184	202	200	204	191
1944	204	206	204	198	194	196	196	194	196	192	198	196	213
1945	194	196	194	196	194	160	168	168	170	172	174	184	185
1946	184	184	184	196	206	226	248	242	232	220	230	226	252
1947	233	243	250	250	250	237	235	230	200	280	293	283	248
1948	289	250	263	278	261	235	233	211	235	222	209	226	230
1949	235	222	213	222	211	191	180	196	209	209	204	209	196
1950	204	215	209	204	215	200	224	215	224	211	222	222	215
1951	222	239	250	239	228	217	228	228	239	239	261	272	235
1952	272	272	261	250	241	217	217	228	250	254	261	239	228
1953	250	239	228	207	217	178	176	185	193	211	222	239	191
1954	211	211	215	207	198	163	163	174	196	209	211	200	183
1955	207	207	202	196	196	163	154	165	165	174	170	167	165
1956	167	167	172	167	163	143	150	159	161	174	189	193	159
1957	189	189	189	189	174	141	157	174	185	189	185	185	161
1958	185	174	185	176	174	163	174	174	196	196	185	185	174
1959	185	196	185	185	174	163	159	170	170	174	183	178	167

Table 57. Hay: Relative prices received by Louisiana farmers, by months, 1910-1959

(Crop year 1935-39=100)

Year	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	Weighted avg.
						per cent							
1910	108	118	124	121	114	115	115	119	118	106	112	110	116
1911	112	121	121	118	112	115	124	125	116	112	110	125	131
1912	133	144	155	157	149	139	131	125	125	117	119	137	129
1913	137	131	128	125	121	118	119	124	123	125	131	126	129
1914	128	136	139	134	128	126	126	128	129	127	124	119	126
1915	112	116	123	131	137	138	138	130	120	119	115	116	124
1916	118	110	119	126	125	118	113	113	113	118	116	116	123
1917	123	130	129	137	161	164	156	148	140	154	157	153	174
1918	182	205	205	213	219	207	187	183	191	198	212	217	217
1919	221	230	246	262	262	241	231	231	204	199	226	231	234
1920	244	244	236	248	253	236	230	215	188	176	163	166	188
1921	177	184	179	164	153	152	148	143	141	134	134	137	137
1922	125	127	128	128	134	143	140	134	133	127	133	145	143
1923	145	144	153	153	159	160	157	146	136	144	152	154	151
1924	154	154	154	149	154	154	154	185	175	185	168	195	186
1925	206	211	226	185	179	182	185	144	154	160	143	185	182
1926	199	215	194	205	216	195	185	206	175	154	153	152	163
1927	139	148	134	144	144	134	139	134	113	134	128	139	141
1928	154	159	149	147	143	145	144	134	135	125	125	135	137
1929	132	137	147	139	139	128	134	123	128	127	127	136	133
1930	131	138	143	134	123	134	123	123	133	134	123	119	124
1931	119	128	128	118	112	113	98	95	86	88	80	82	89
1932	84	83	90	76	76	72	72	72	77	77	83	79	76
1933	69	74	74	71	77	77	71	85	82	78	74	77	80
1934	85	76	84	77	72	82	83	83	98	96	92	100	99
1935	103	113	123	109	104	106	95	90	87	82	98	90	97
1936	97	91	110	96	109	90	95	110	117	108	98	106	107
1937	114	113	108	106	109	108	104	96	101	100	105	100	104
1938	103	111	104	103	106	98	102	92	92	96	88	98	95
1939	92	92	103	103	92	85	91	82	89	83	91	91	118
1940	99	110	110	103	107	98	96	79	80	96	86	92	110
1941	88	91	96	98	103	103	92	84	92	95	92	96	96
1942	99	107	113	116	111	109	103	97	105	108	110	119	114
1943	125	141	146	148	132	128	144	149	146	149	164	166	230 1/
1944	181	190	189	188	164	158	154	164	170	157	171	172	225 1/
1945	171	190	175	164	164	170	164	164	149	154	149	164	222 1/
1946	164	170	164	164	159	154	165	165	176	173	185	185	242 1/
1947	186	179	184	186	168	156	167	163	194	199	205	210	257 1/
1948	213	217	248	225	209	208	252	269	226	264	275	286	273 1/
1949	278	273	293	275	264	245	239	226	231	221	227	235	233
1950	246	226	217	229	270	220	210	212	223	236	263	274	253
1951	268	287	299	270	256	266	260	269	262	281	315	302	295
1952	331	323	316	291	291	273	272	296	301	315	324	324	308
1953	319	304	287	285	275	251	261	261	248	244	263	324	262
1954	286	258	264	266	253	238	226	241	246	244	255	261	253
1955	271	251	255	247	251	214	228	232	211	224	215	219	225
1956	226	236	226	202	214	212	195	194	220	238	240	248	236
1957	268	268	256	248	231	220	233	216	229	229	244	244	238
1958	244	257	266	251	239	225	226	218	229	212	213	221	224
1959	227	232	232	227	213	229	224	210	220	220	225	232	228

1/ Data obtained from U.S.D.A. Bulletin 229, Hay, by States, 1866-1953.

Table 58. Sweet potatoes: Relative prices received by Louisiana farmers, by months, 1910-1959

(Crop year 1935-39=100)

Year	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	Weighted avg.
						per cent							
1910	81	81	86	92	85	80	89	105	109	96	78	74	101
1911	84	88	95	107	111	103	122	107	107	97	81	77	106
1912	88	92	108	124	112	107	115	114	115	97	89	80	110
1913	95	101	107	116	122	108	95	108	101	95	88	81	104
1914	95	88	101	107	108	108	119	115	96	96	78	70	99
1915	74	84	93	100	115	108	107	103	88	74	58	65	85
1916	76	77	99	88	88	88	108	107	96	85	81	81	107
1917	88	95	128	128	135	135	135	135	155	135	128	135	165
1918	135	162	203	200	169	135	155	189	182	202	189	158	216
1919	176	216	223	270	230	230	243	284	297	176	162	149	238
1920	203	216	216	243	257	338	270	270	255	166	120	122	171
1921	134	122	122	177	151	157	208	147	115	111	93	88	124
1922	95	99	115	130	122	139	164	143	119	114	78	69	131
1923	112	126	143	143	147	141	126	146	219	159	141	135	182
1924	149	203	176	169	216	203	176	230	236	211	223	234	251
1925	203	257	332	459	416	270	247	238	281	281	181	134	238
1926	197	177	196	203	243	203	149	216	189	162	95	108	156
1927	122	149	149	149	149	176	155	162	169	122	108	128	146
1928	115	115	128	142	142	142	128	128	135	115	115	115	199
1929	115	142	149	142	162	196	196	189	169	149	128	135	171
1930	135	135	142	162	189	189	176	182	169	155	128	128	163
1931	122	122	128	149	149	115	108	123	101	88	74	61	88
1932	74	74	74	68	68	68	68	74	62	61	54	54	68
1933	54	55	58	62	88	88	88	122	95	81	68	81	96
1934	88	88	88	88	95	115	95	108	115	95	88	88	109
1935	88	95	108	108	115	108	115	101	81	74	68	68	85
1936	74	74	74	81	95	101	122	169	108	122	101	101	128
1937	108	115	128	149	149	135	115	108	108	88	81	88	101
1938	88	95	101	95	108	115	101	115	81	74	68	74	94
1939	74	88	88	95	108	108	115	108	81	74	68	74	92
1940	74	95	101	101	101	115	115	122	115	101	88	95	112
1941	95	108	108	115	115	122	128	122	108	95	81	88	106
1942	95	101	101	101	101	108	122	182	142	135	115	135	147
1943	149	155	216	223	243	243	608	297	264	243	216	203	266
1944	209	223	243	257	284	311	264	257	169	182	169	182	213
1945	209	230	236	236	270	270	304	304	128	149	182	216	215
1946	216	257	284	297	318	331	331	270	162	189	203	236	231
1947	278	278	250	250	234	323	262	331	222	177	198	323	224
1948	242	323	270	278	278	258	331	222	314	180	198	222	235
1949	367	367	339	395	266	310	430	314	270	234	222	242	249
1950	250	234	222	242	198	117	145	145	133	101	117	182	144
1951	206	206	206	206	222	222	222	410	403	359	331	440	419
1952	528	528	581	661	661	682	907	456	367	331	395	528	401
1953	556	371	617	645	617	540	601	323	222	258	286	528	278
1954	278	294	256	323	256	258	367	133	186	198	270	367	272
1955	222	222	226	226	218	1/	1/	176	154	117	147	176	146
1956	154	140	140	117	125	-	-	161	198	169	182	194	208
1957	274	274	274	242	-	-	391	222	194	177	157	391	264
1958	403	427	407	448	-	-	444	282	169	133	169	226	179
1959	234	198	169	182	169	-	-	157	125	109	101	169	129

1/ Not quoted.

Table 59. Irish potatoes: Relative prices received by Louisiana farmers, by months, 1910-1959

(Crop year 1935-39=100)

Year	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	Weighted avg.
						per cent							
1910	112	122	120	106	91	78	73	82	88	92	99	94	99
1911	98	106	107	98	89	89	93	112	122	124	118	111	108
1912	116	118	122	139	139	117	100	98	99	89	88	96	139
1913	104	112	122	124	120	102	84	87	96	111	114	107	124
1914	109	120	124	116	111	103	96	106	111	116	116	116	123
1915	122	124	127	123	123	118	102	100	100	104	110	98	133
1916	97	124	156	152	127	113	104	111	139	174	190	193	144
1917	205	257	311	324	307	291	268	256	244	214	208	206	328
1918	211	240	249	220	149	96	107	136	159	170	176	183	129
1919	209	204	196	211	222	200	180	177	169	202	242	253	229
1920	289	351	364	400	344	383	294	311	269	242	230	222	277
1921	211	216	224	183	172	167	156	177	191	204	209	204	206
1922	216	256	279	206	173	146	156	156	158	187	194	167	171
1923	169	197	239	226	178	161	161	150	164	180	178	172	184
1924	204	167	139	156	150	161	128	133	183	178	178	156	159
1925	166	167	167	161	148	189	194	233	240	214	326	307	168
1926	264	311	311	311	283	159	147	189	167	167	178	200	253
1927	211	211	211	283	144	172	217	189	189	172	172	172	214
1928	167	167	178	178	130	78	100	94	94	122	128	128	127
1929	139	150	144	183	178	144	161	167	189	189	183	178	190
1930	172	178	178	250	153	144	144	150	183	161	144	144	171
1931	144	139	139	122	89	56	56	56	67	67	94	100	63
1932	99	89	106	133	117	61	61	61	72	89	67	78	87
1933	67	72	89	111	82	83	89	133	156	117	117	100	92
1934	128	128	144	100	81	42	67	83	83	83	100	111	65
1935	117	106	106	156	67	67	83	72	83	89	106	106	89
1936	100	89	106	139	128	161	133	144	144	144	156	150	158
1937	150	178	122	78	50	56	67	83	89	89	94	94	82
1938	94	106	100	67	67	61	67	78	89	83	89	106	76
1939	106	94	117	122	72	67	72	89	122	106	100	106	95
1940	111	122	122	128	90	87	89	94	89	94	106	94	103
1941	89	94	94	122	68	61	67	78	94	106	111	122	77
1942	139	156	156	178	133	89	106	139	133	144	144	150	141
1943	150	161	183	261	169	178	179	189	200	206	206	217	199
1944	217	217	228	150	139	122	122	161	183	200	189	189	154
1945	206	211	239	217	211	204	233	256	233	222	206	200	214
1946	222	222	239	217	144	128	189	211	211	222	222	211	165
1947	211	235	254	254	208	189	189	208	220	235	235	273	202
1948	284	284	284	284	235	216	227	227	239	246	250	227	242
1949	239	239	254	254	235	235	273	239	254	227	239	239	242
1950	250	250	239	182	189	189	220	254	269	250	239	254	195
1951	258	239	258	284	216	170	220	254	254	258	348	235	211
1952	326	326	326	348	333	337	348	348	348	348	348	330	327
1953	348	511	348	140	140	106	159	159	174	201	1/	348	139
1954	-	-	-	201	174	144	180	254	303	-	-	-	170
1955	-	-	-	-	211	252	221	-	-	-	-	-	336
1956	-	-	-	364	296	296	-	379	-	-	-	-	302
1957	-	-	-	-	152	152	136	-	-	-	-	-	153
1958	-	-	-	-	212	163	167	-	-	-	-	-	189
1959	-	-	-	-	212	258	-	-	-	-	-	-	219

1/ Not quoted.

Table 60. Peanuts: Relative prices received by Louisiana farmers by months, 1910-1953

(Crop year 1935-39=100)

Year	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	Weighted avg.
						per cent							
1910	58	69	74	70	64	68	80	62	64	70	64	60	72
1911	100	90	80	90	90	84	100	94	94	96	74	80	82
1912	64	78	78	100	80	100	100	82	50	80	70	60	70
1913	74	64	58	80	86	100	100	80	80	94	76	78	82
1914	80	80	70	80	70	100	140	100	80	74	80	78	86
1915	140	80	50	120	112	106	100	130	140	120	100	84	98
1916	90	100	88	80	80	90	100	110	90	90	88	100	96
1917	104	90	120	108	140	120	106	100	100	110	120	130	126
1918	140	146	140	120	128	170	120	120	120	120	130	140	136
1919	120	158	172	172	174	168	160	140	180	200	180	200	192
1920	180	180	220	200	200	240	206	200	120	180	110	110	130
1921	160	120	128	120	140	100	120	140	160	140	120	120	128
1922	150	108	140	122	126	206	144	170	108	108	138	138	128
1923	108	130	120	120	120	140	140	140	140	160	150	140	146
1924	130	130	136	130	124	120	120	100	120	120	120	132	126
1925	130	130	140	130	164	144	162	152	140	120	118	126	122
1926	128	128	130	112	130	140	150	138	160	150	120	128	136
1927	130	146	130	114	136	150	166	140	148	148	150	136	148
1928	132	152	156	162	172	154	154	154	132	136	146	140	144
1929	152	142	138	142	148	158	154	152	140	132	132	136	134
1930	140	128	128	128	140	130	134	130	136	130	138	130	128
1931	124	106	120	120	130	122	110	110	90	80	76	78	84
1932	72	74	76	80	84	76	86	80	78	78	74	76	76
1933	70	72	74	82	84	84	92	78	84	94	86	82	88
1934	88	96	88	90	94	88	90	80	84	80	80	92	94
1935	94	94	102	108	96	92	100	96	96	94	92	96	97
1936	92	110	98	94	96	84	120	86	90	102	104	112	99
1937	112	106	98	114	112	110	108	108	102	96	96	96	105
1938	96	98	108	108	112	114	112	108	98	96	92	98	103
1939	100	104	104	104	106	108	108	108	114	106	110	104	106
1940	94	98	98	104	112	108	112	112	100	96	100	98	103
1941	98	102	98	100	100	100	100	106	106	106	114	116	104
1942	116	118	134	144	142	132	132	138	100	100	100	106	122
1943	110	116	120	130	140	140	140	140	140	150	142	150	135
1944	150	164	164	170	170	170	170	180	166	164	170	170	167
1945	170	168	174	174	180	180	180	180	180	180	180	180	177
1946	180	190	194	196	202	204	204	204	204	204	224	216	202
1947	216	216	228	250	240	240	240	240	250	250	260	260	241
1948	270	260	260	300	300	300	300	300	280	280	280	280	284
1949	280	280	280	260	260	260	280	280	250	250	280	280	270
1950	280	280	280	280	280	280	280	300	300	300	300	300	289
1951	300	300	300	300	300	300	300	300	290	290	290	300	298
1952	300	300	300	300	300	300	300	300	320	320	320	320	307
1953	320	320	320	320	320	320	320	320	320	320	320	320	320
1954	1/												

1/ Discontinued after 1953.

Table 61. Season price relatives received by Louisiana farmers for crops not marketed throughout the year, 1910-1959

(Crop year 1935-39=100)

Year	Sugar cane	Sirup	Oranges	Pears	Peaches	Straw-berries	Pecans
	---------- per cent ----------						
1910	120	116	-	-	92	-	-
1911	140	116	-	-	92	-	-
1912	121	108	-	-	73	-	-
1913	102	113	-	-	138	-	-
1914	122	113	-	-	92	-	-
1915	148	126	-	-	87	-	-
1916	172	145	-	-	78	-	-
1917	231	155	-	-	115	-	-
1918	237	179	-	-	128	172	-
1919	456	282	208	189	165	187	302
1920	188	253	130	265	248	201	323
1921	118	142	178	347	133	195	219
1922	190	129	171	259	133	129	226
1923	231	153	63	258	174	180	195
1924	182	113	128	288	170	195	274
1925	132	92	166	220	161	180	206
1926	160	108	157	197	138	200	180
1927	150	116	262	212	165	156	211
1928	126	97	187	205	147	180	145
1929	123	108	213	205	156	132	190
1930	110	95	114	197	161	153	150
1931	107	103	99	136	96	123	98
1932	100	89	96	106	96	72	86
1933	107	87	107	152	100	78	73
1934	76	97	79	83	69	83	129
1935	104	105	121	114	96	101	91
1936	121	95	121	98	101	104	127
1937	95	108	102	106	115	92	85
1938	87	100	75	76	92	105	99
1939	94	92	82	106	96	97	100
1940	89	105	75	76	92	108	101
1941	128	147	90	91	96	85	104
1942	142	163	168	99	119	123	160
1943	150	195	254	258	284	217	210
1944	162	174	194	189	275	295	195
1945	182	195	190	197	271	304	220
1946	213	316	142	227	280	311	320
1947	236	211	131	219	261	269	246
1948	192	211	138	189	266	310	128
1949	202	184	164	197	257	318	178
1950	257	211	169	197	312	287	275
1951	191	224	284	235	312	262	201
1952	216	247	261	227	303	326	208
1953	231	245	257	220	261	297	163
1954	218	229	216	204	335	224	270
1955	204	229	190	220	1/	339	307
1956	253	216	287	205	303	307	190
1957	218	226	246	227	307	352	232
1958	241	231	246	197	220	312	286
1959	221	226	287 2/	197	229	290	338

(Continued)

1/ Crop failure.
2/ 1958 price relative.

Table 61. Season price relatives received by Louisiana farmers for crops not marketed throughout the year, 1915-1959 (Continued)

(Crop year 1935-39=100)

Year	Cowpeas	Cabbage	Spring beans	Fall beans	Water-melons	Green peppers	Tomatoes	For processin
	---------- per cent ----------							
1915	110	-	-	-	-	-	-	-
1916	88	-	-	-	-	-	-	-
1917	144	-	-	-	-	-	-	-
1918	160	276	242	-	-	-	-	-
1919	189	264	253	-	-	-	-	-
1920	228	202	242	-	-	-	-	-
1921	148	113	296	-	-	-	-	-
1922	132	100	172	175	-	-	-	-
1923	147	214	274	185	-	-	-	-
1924	229	245	194	185	-	206	-	-
1925	216	113	145	185	-	190	316	-
1926	165	177	231	165	-	222	189	-
1927	147	109	145	130	-	190	105	-
1928	164	116	167	155	-	143	132	284
1929	172	111	145	110	-	148	132	213
1930	148	180	113	103	-	111	116	150
1931	82	83	87	95	-	103	132	149
1932	70	133	59	60	-	135	153	110
1933	98	108	88	68	-	95	95	87
1934	119	53	77	80	78	76	74	100
1935	107	115	76	101	93	78	79	77
1936	121	93	129	90	103	76	105	98
1937	100	115	124	135	99	95	132	100
1938	90	73	75	80	104	79	63	104
1939	82	103	97	95	132	175	121	122
1940	90	120	124	65	144	127	84	111
1941	124	110	134	165	156	95	121	124
1942	150	83	151	190	208	183	189	174
1943	200	339	247	240	448	516	368	303
1944	204	141	242	245	461	302	342	275
1945	210	131	269	275	547	349	353	260
1946	262	201	226	240	432	349	368	326
1947	291	99	247	240	328	444	268	354
1948	263	227	296	230	460	317	368	316
1949	216	146	296	150	419	413	268	301
1950	264	77	263	220	489	238	600	186
1951	285	309	369	295	484	151	389	294
1952	274	291	290	320	437	706	579	315
1953	271	84	269	190	500	690	842	394
1954	268	127	177	245	440	182	352	316
1955	229	166	215	180	305	238	437	168
1956	256	126	296	185	432	524	821	160
1957	268	196	271	249	463	405	665	182
1958	262	191	210	204	401	254	508	183
1959	244	156	223	240	370	349	581	153 1/

1/ Estimated.

30.75
93b
d set

The Home Fruit Garden In Louisiana

By E. N. O'Rourke, Jr.

TECHNOLOGY AND SCIENCE ROOM

Bulletin No. 531 May 1960

UNIVERSITY OF MARYLAND
LIBRARY
MAR 27 1961

Louisiana State University
and
Agricultural and Mechanical College
Agricultural Experiment Station
Charles W. Upp, Director

CONTENTS

Page

Introduction 3

Plant the Right Variety 3

- Chilling Requirement 4
- Cold Hardiness 4
- Warm Weather Adaptability 4
- Ripening Season 4
- Disease and Insect Resistance 5
- The Size of Plants 5
- Pollination Requirements 6
- Fruit Varieties Recommended for Home Planting 6

Plan the Planting 9

Buy Good Nursery Stock 9

Plant Properly 10

- Tree Fruits 10
- Bush Fruits and Vines 10
- Strawberries 11

Good Culture Pays 11

- Sod, Mulch, or Clean Cultivation? 11
- Fertilization 12
- Pruning 14
  - Tools 15
  - Protect Large Pruning Wounds 15
  - Tree Fruits Other than Citrus 15
  - Citrus 17
  - Grapes 18
  - Brambles 20
  - Blueberries 20
- Control of Diseases and Insects 21
- Fruit Thinning 22
- Harvesting 22
- Winter Protection 22

ACKNOWLEDGEMENTS

The author is grateful for critical appraisal of the manuscript by Dr. J. C. Miller, Dr. J. R. King, and P. L. Hawthorne, of the L.S.U. Horticultural Research Department, and by Professor B. H. Singletary and Dr. W. D. Kimbrough of the L.S.U. Horticulture Department.

The Home Fruit Garden in Louisiana

E. N. O'Rourke, Jr.

Professor of Horticulture, Agricultural Experiment Station

INTRODUCTION

Fruit growing in the home garden provides an interesting hobby which can be profitable. Although many of the fruits that the homeowner can grow are obtainable in the market, the quality of many is best when fruit is allowed to ripen on the plant, and there is much satisfaction in producing good fruit for the use of family and friends. Some fruits are not commonly marketed, and the home garden is the only source. In addition, many fruit plants are ornamental, particularly during bloom, and add to the landscape planting.

Most home garden sites are fairly small and the area near the home may not be as well adapted as one would desire for commercial fruit planting. Planning the garden to best utilize the available space is of primary importance.

At least 25 kinds of fruit can be grown with variable success in Louisiana. Some are so well adapted that commercial fruit growing industries are based upon them, while some are only adapted to growing in the home garden, and some are adapted only to certain small areas and offer little chance of success in others. Apples, crab apples, and bunch grapes are only recommended for the most northerly parishes in Louisiana, although they can be found growing with fair success in scattered locations throughout most of the state north of Baton Rouge. The planting of loquats, grapefruit, tangelos, mandarins, lemons, sweet oranges, and tangerines is only recommended in the most southerly parishes in the state, while satsumas and kumquats will succeed fairly well south of Baton Rouge. Figs, peaches, nectarines, pears, plums, persimmons, pecans, guavas, strawberries, muscadine grapes, bramble fruits, and blueberries are grown with fair success in all parts of the state which are suitable for crop production. The selection of the proper varieties within each group is very important as varieties differ widely in their requirements.

PLANT THE RIGHT VARIETY

A combination of weather and soil conditions influences the performance of fruit plants. The ability of a variety to perform well under any special conditions makes it an "adapted" variety to these conditions. Some of these conditions are briefly discussed here.

Chilling Requirement

Most fruit plants that originated in the temperate zone go through a period of inactivity called the "rest period." This usually occurs in the winter and is often associated with dormancy due to weather conditions, and loss of leaves in some species. Exposure to temperatures below about 45° F. for a period of time satisfies the rest period requirement and prepares a plant to become active again when weather conditions are favorable. The length of this period of low temperature varies with species and varieties and accounts for the fact that some varieties, such as the "Pineapple" pear, bloom almost as soon as the first warm spell in spring, often being injured by later cold weather, while many other varieties of pears do not bloom until a month or more later.

A plant that does not receive enough cold weather to satisfy its rest period requirement does not perform well. Such plants often are delayed in leafing out and blooming and will have a scattered bloom over a long period of time, or blossoms may drop. In extreme cases, plants will not live more than a season or two in areas with warm winters.

Cold Hardiness

Injury to plants by low temperatures can occur in almost all parts of Louisiana. In some cases the injury is caused by temperatures which are not extremely low but which occur when the plant is not in a condition to stand the cold. The cold may kill flowers, resulting in loss or reduction of crop, or may injure the trunk or branches in some cases. Deciduous fruits, except the fig, when fully dormant can withstand any temperature that is likely to occur in Louisiana. The choice of varieties that will remain dormant during crucial periods is very important.

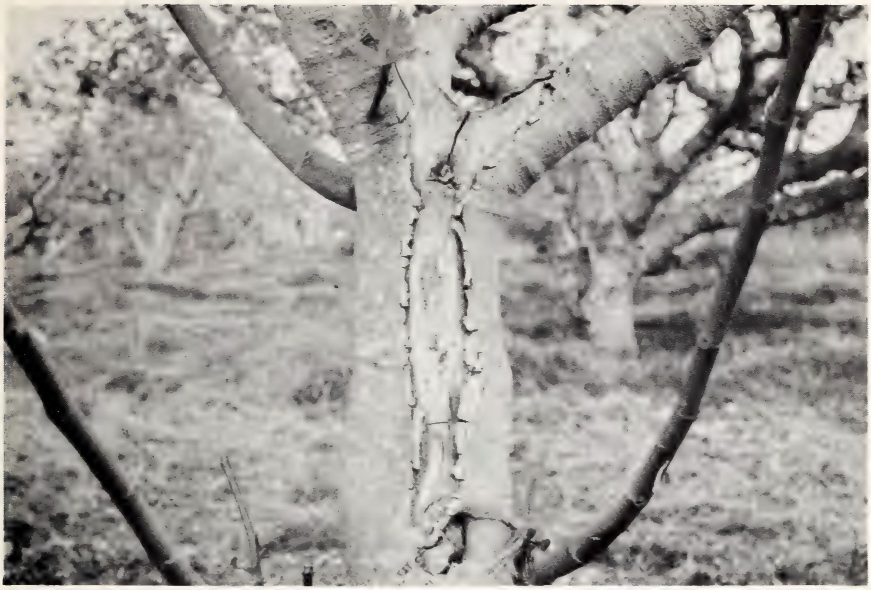
Some varieties are naturally susceptible to damage by temperatures commonly encountered in the northern part of Louisiana. These should be avoided in favor of more hardy varieties. Citrus, for example, is adapted only in parts of the coastal parishes and is subject to winter injury in other locations. Fig trees when fully dormant withstand temperatures down to about 15° F., below which damage usually occurs.

Warm Weather Adaptability

Some varieties of fruits will grow satisfactorily but will not produce quality fruit in Louisiana because of the warm, humid weather encountered during the period of fruiting. Most apple varieties are in this class, as are many bunch grape varieties.

Ripening Season

Planting several varieties of one kind of fruit which ripen at different times is desirable to lengthen the period of availability of



Winter injury to trunk of fig tree.

fruit. Pears of different varieties ripen from early summer until early winter, for example. In certain cases fruit that ripens at a particular time has a much more favorable environment for ripening than varieties that mature earlier or later.

Disease and Insect Resistance

Many home fruit growers are not prepared to spray for control of insects and diseases. In such a case the grower should plant only those fruits that can be expected to produce a reasonable crop without spraying. There are certain varieties of pears, figs, plums, loquats, persimmons, pecans, guavas, blueberries, and muscadine grapes that require little attention for control of insects and diseases. Many desirable fruits, however, cannot be grown successfully without spraying. Where spraying is necessary it can be more easily accomplished where small trees are grown. This is one reason why dwarf trees have become popular in recent years.

The Size of Plants

The size of mature trees will determine how many plants of a kind should be planted in a given area. Pecans produce very large trees that often are not adapted to small lots. Apple and pear trees usually require an area about that of a circle with a 20-foot diameter. Some trees can be grown on rootstocks that dwarf them. These dwarf trees can be obtained from most nurserymen but may have to be ordered in advance to allow the nurseryman to propagate the desired variety.

Pollination Requirements

Many varieties of fruit will not bear unless the flowers are pollinated by another variety. A common example is the Japanese plum. Where cross-pollination is needed, the two varieties selected must bloom at the same time. The nurseryman should supply information about the pollination requirements of the varieties that he sells. Most pears, apples, and imperfect-flowered muscadine grapes require a pollinator. Planting varieties whose pollination requirements are unknown is not recommended.

Fruit Varieties Recommended for Home Planting

Varietal recommendations for the home fruit garden cannot be rigidly specific. Since sites vary so much from place to place even within a short distance and since the cultural practices differ with the homeowner, it is difficult to say whether a variety will succeed or not. The recommendations given here are based on performance reported by horticulturists in Louisiana and neighboring states and by home gardeners in Louisiana. A list is given in Table 1. The terms "North Louisiana" and "South Louisiana" are rather general terms used to indicate the areas in which the specific varieties of fruit are most likely to succeed. For example, in the case of all citrus except the satsuma and kumquat, the term "South Louisiana" means only the coastal parishes, while for the satsuma it means those areas that lie south of Baton Rouge, and for the kumquat the range may extend even farther north. Specific information about a variety's adaptability can often be supplied by the nurseryman, county agent, or Extension horticulturist.

TABLE 1. Fruit Varieties Recommended for Louisiana

Fruit	Variety	Recommended for	
		North La.	South La.
Apples	Golden Delicious	X	
	Red Delicious	X	
	Stayman Winesap	X	
	Anoka	X	
	St. Clair	X	
	Yates	X	
	Lodi	X	
	Early Harvest	X	
	Hackworth	X	
	Brilliant	X	X
Crab Apples	Transcendent	X	
	Hyslop	X	
	Dolgo	X	
	Native seedlings	X	X
Citrus			
Satsumas	Owari		X

Continued

TABLE 1. Fruit Varieties Recommended for Louisiana—*Continued*

Fruit	Variety	Recommended for	
		North La.	South La.
Citrus—*Continued*			
Sweet Oranges	Pineapple		X
	Washington navel		X
	Parson Brown		X
Grapefruit	Marsh		X
	Ruby		X
Kumquats	Nagami		X
	Meiwa		X
Tangelos	Orlando		X
Mandarins	Ponkan		X
Lemons	Meyer		X
	Ponderosa		X
Tangerines	Dancy		X
Figs	Celeste	X	X
	Hunt		X
	Florentine		X
	Southeastern Brown Turkey	X	X
Loquats	Champagne		X
	Early Red		X
	Native seedlings		X
Peaches*	Hermosa		X
	Meadow Lark		X
	Merrill's Gold Rush		X
	Merrill's Forty-niner		X
	Red Wing		X
	Robin		X
	Sunglow		X
	Red Globe	X	
	Red Haven	X	
	Southern Glow	X	
	Golden Jubilee	X	
	Dixigem	X	
	Southland	X	
	Summercrest	X	
	Sullivan's Early Elberta	X	
	Elberta	X	
	Georgia Belle	X	
Nectarines	Silverlode	X	X
	Pioneer	X	
Pears	Baldwin	X	X
	Leconte	X	X
	Garber	X	X
	Pineapple	X	X

Continued

*Peach variety information cited from L.S.U. Extension Publication 1095, *Louisiana's Program for Peach Production,* by Bertha Lee Ferguson, R. S. Woodward, and P. L. Hawthorne; Horticultural Research Circular 21, January, 1954, *Peach Varieties for the Upland Area of South Louisiana,* P. L. Hawthorne and H. D. Ellzey, Jr.; and *Home Orchards for Northern Louisiana,* Donald H. Spurlock, L.S.U. Extension Mimeograph, February, 1957.

TABLE 1. Fruit Varieties Recommended for Louisiana—*Continued*

Fruit	Variety	Recommended for North La.	Recommended for South La.
Pears—*Continued*			
	Orient	X	X
	Maxine	X	
Persimmons	Tanenashi (Japanese)	X	X
	Fuyu (Japanese)	X	X
	Native-seedlings	X	X
Plums	Excelsior	X	X
	Methley	X	
	Santa Rosa	X	X
	Hybrids of local origin	X	X
Pecans	Stuart	X	X
	Elliott	X	X
	Desirable	X	X
	Local seedlings	X	X
Guavas	Feijoa (strawberry guava)	X	X
Strawberries*	Klonmore		X
	Konvoy	X	X
	Headliner	X	X
Grapes			
Bunch grapes	Champanel	X	X
	Niagara	X	
	Delaware	X	
	Beacon		X
Muscadine grapes Imperfect-flowered:**			
	Scuppernong	X	X
	Thomas	X	X
	Hunt	X	X
	Topsail	X	X
	Yuga	X	X
	Higgins	X	X
Perfect-flowered muscadines			
	Dearing	X	X
	Burgaw	X	X
Brambles Trailing Types:			
	Boysenberry	X	X
	Native seedlings	X	X
Blueberries			
	Coastal	X	
	Tifblue	X	

---

*Information furnished by P. L. Hawthorne, Assoc. Horticulturist.

**Must be planted with perfect-flowered types to insure fruit set on the imperfect-flowered vines.

PLAN THE PLANTING

Most home gardeners have little choice in the location of the fruit planting, but where high land is available it should be selected for most fruit plants. Well-drained soil is needed to allow root activity to start in early spring when the above-ground parts of the plant begin to grow. Air drainage will lessen the chance of frost damage to early-blooming plants, and a slope which allows cold air to drain from the planting is desirable. Small fruits can be grown on raised rows in locations where the soil drainage is poor, but this is not practical with trees.

The soil should have the ability to hold enough water to supply the planting through dry periods. Where water can be supplied in drouth periods it will greatly aid the chance of success, especially with shallow-rooted plants and young plants of tree fruits.

Large trees may shade plants that are planted too near them, and in addition compete for water and nutrients. Buildings may shade and cause reduced vigor of plants that are located too close to them.

A small planting that receives proper care will produce more desirable fruit than a large planting that is neglected. The grower should seriously consider planting dwarf trees of those varieties that can be obtained on dwarfing rootstocks. Other varieties can be kept small by pruning.

BUY GOOD NURSERY STOCK

The difference in cost between a good plant and an inferior plant is usually a small item in the total cost of establishing any planting. A large plant is not always better than a smaller plant and is usually more difficult to establish. Many home gardeners cannot resist buying a large plant because it seems logical that it should become productive earlier than a smaller plant. The most common fault of large fruit plants is that they are allowed to dry out during the interval from the nursery to the permanent location and lose a greater proportion of their roots in the transplanting process.

Deciduous trees should be moved while they are dormant and leafless. Evergreen trees, such as citrus and loquat, are moved by digging so that remaining roots are in a solid "ball" of soil. This soil is usually wrapped and fastened in burlap for handling. Such plants are called "balled and burlapped" by nurserymen.

Nursery stock should be examined on receipt to see if it is in good condition and shows no evidence of drying, dead, or diseased tissues. It is best to set out fruit plants immediately upon receipt, but where the grower is unable to do so he should remove the plants from the bundle and place them in a temporary trench, spreading the roots and sifting soil around them well. This is called "heeling in." This is not necessary with balled plants, but they must not be allowed to become dry.

If recommended varieties are not offered for sale by local nursery outlets they can usually be obtained by requesting the nurseryman to propagate them for the next season.

PLANT PROPERLY

Tree Fruits

At the time of planting inspect the tree for broken branches or broken or discolored roots. These should be removed by cutting back to healthy tissue. Exceptionally long roots may be cut into better proportion with the others.

Dig a hole deeper than needed to fit the root system and wide enough to accommodate the roots without crowding. Some topsoil should be placed in the bottom of the hole before placing the tree in it. Place the tree upright at the depth that it stood in the nursery. This can usually be determined by the color of the bark near the base of the trunk. While holding the tree upright, sift soil around the roots. Moving the tree slightly will aid in filling any holes around the roots. The soil should be firmly packed into the hole several times during the filling of the hole. After the hole is filled the ground should be level. If the soil is very dry, water the tree before the hole is entirely filled, then after the water has penetrated, finish filling the hole with soil that has not been wet.

Commercial fertilizers should not be placed in contact with plant parts. It is dangerous to place fertilizer in the hole at planting time, as commercial fertilizers may damage roots that they contact and organic material, such as manures, if not fully decomposed, may heat to the point where roots are damaged. Fertilizer should be placed on the surface after planting, usually spread on the area of about a three-foot circle around the trunk.

The important point in planting is that the roots must be in contact with moist soil in order that they may take up water to supply the needs of the plant. Planting in water-logged soil will often result in very poor survival. Roots must have oxygen in order to function and live. A tree planted in water-logged soil may well die for lack of water in the tissues, as the roots cannot obtain enough water in such an environment.

Plantings on slopes should be made on contour rows to prevent soil erosion. On poorly drained sites raised beds may be beneficial for species or varieties which are not tolerant of wet soil conditions. This is not practical for large trees.

Bush Fruits and Vines

Bush fruits and vines are planted in much the same way as trees, except that the scale of size is different. The same essential points must be considered, such as prevention of drying out of tissues, proper depth of planting, and proper use of fertilizers at planting time.

Strawberries

Strawberries are usually grown in the hill system in Louisiana. Plants are set on raised rows and are planted in single or double rows, with plants 12 to 15 inches apart. The plants are set out in late October or November and are grown only one year. The proper depth for strawberries is about one-half inch above the point where the roots join the stem at the crown. Fertilizer injury is common on strawberries, and proper placement is important to prevent contact with tissues. The fertilizer should be thoroughly mixed with the soil at least two weeks before planting.

Most soils for strawberry production can be improved by the addition of organic matter. Barnyard manure is an excellent additive. A cover crop of a legume such as cowpeas supplies organic matter. This should be turned under long enough before planting to insure that there is no heating at the time the plants are set out.

GOOD CULTURE PAYS

Sod, Mulch, or Clean Cultivation?

Perhaps the first decision concerning culture in the fruit planting will be whether to maintain the area beneath the trees in clean cultivation, sod, or mulch. Since all plants require space, light, water, and nutrients, all plants that share an area with fruit plants compete with them for these requirements. Clean cultivation eliminates competition by weeds or grass but may not always be desirable in the home fruit planting. Labor and time are required to keep the soil surface free of weeds and grass, and the home gardener may well wish to spend his time and labor on some other activity. During rainy periods the uncovered soil surface may be a nuisance in the garden area and may erode if the planting is on a slope.

Where clean cultivation is practiced in summer, a winter cover crop may be grown beneath the trees. This may be a grass, such as oats or rye, or a legume, such as crimson clover or peas. The cover crop should be turned under before growth of the trees begins in the spring. Cover crops aid in controlling erosion and add organic matter and nutrient elements to the soil, improving its structure in the process.

After trees are established the lawn grass may be allowed to grow under the trees up to the trunks. Competition with the trees will exist, however, and the grower should keep the grass mowed closely and supply enough fertilizer for both the lawn and the tree. When trees are small they may require irrigation during dry spells if a competing sod is growing around them.

Mulches are ground coverings usually composed of some organic litter, such as straw, dead leaves, or pine needles. The mulch serves several purposes. It prevents competition from grass and weeds by shading the competing plants so that they do not grow. It conserves soil moisture by acting as a barrier against evaporation. It prevents erosion by breaking the force of rain and water on the soil surface. It adds organic matter and nutrients to the soil as it decays. Finally, it maintains the upper soil in a favorable condition for root growth so that trees grown in such an environment produce more fibrous roots in a zone where many nutrients are available. Mulches must be renewed, however, as they decay, and may not be practical where mulching material is not readily available. In some areas the use of mulches causes an increase in the population of mice in the planting, with the possibility of damage by the mice to the roots and bark of the trees.

Among small fruits, strawberries and blueberries are almost always grown in a mulch system. Grapes, guavas, and brambles may be grown in a mulch system or under clean cultivation. Sod culture has no place in growing small fruits. The mulch is used to keep the fruit of strawberries clean, in addition to its other benefits.

Fertilization

All plants require nitrogen and mineral nutrients from the soil. Soils vary in their supply of these elements, and plants vary in their needs and their ability to obtain them from the soil. Soil conditions vary so greatly from site to site, particularly in city areas, that only general fertilizer recommendations can be used as a guide. If problems arise which seem due to some soil problem, the county agricultural agent can be consulted.

It is important to maintain the leaves of fruit plants in a dark green condition and to maintain adequate annual shoot growth. Yellowish or scorched leaves or a deficiency of shoot growth all indicate fertility problems. More shoot growth is desirable on some species than on others. For example, peaches, nectarines, and many American plums bear fruit along shoots that were produced in the previous season. Figs and grapes bear fruit along shoots produced in the same season. The length of shoots, therefore, greatly influences the amount of fruit produced. Apples and pears and some plums, on the other hand, bear much of their fruit on short shoots called "spurs," which may grow only an inch or less each season. It is not as necessary in this case to produce long shoot growth. Fertilizer on fruit trees is applied broadcast in a circle extending beyond the spread of the branches and is usually applied in early spring before growth starts.

Peaches and plums grown on light, well-drained soils are usually given one pound of a complete fertilizer of 8-8-8 analysis per year of tree age. In addition, one-half to one pound of 16 per cent nitrogen fertilizer or its equivalent should be applied in June if the leaves are yellowish or shoot growth is inadequate. At 10 years of age the trees receive the maximum amount, which is continued for the life of the tree.

Apples and pears should receive one pound of 8-8-8 fertilizer or its equivalent per year of tree age until about 15 years of age, depending on the size of the tree, after which the maximum amount is applied annually.

Dwarf trees require considerably less fertilizer than standard size trees. A good rule to apply is to gauge the amount by that which a standard tree of the same size should receive.

Pecans are usually given two pounds of 8-8-8 fertilizer per year of tree age. This is varied according to the vigor and size of the tree.

Fig trees should make about 12 to 18 inches of shoot growth each year. Fertilizer requirements may be gauged by the amount of growth made in the previous season. In general, one pound of 8-8-8 fertilizer per year of tree age should be applied up to 10 years of age, after which the maximum rate should be continued. If mulch is applied, the amount of commercial fertilizer may be reduced.

Crab apple trees should be fertilized about like apple trees, based on the requirements for apple trees of the same size.

Little is known of the requirements of loquats, guavas, and persimmons, but adequate shoot growth and healthy leaf area must be maintained. A complete fertilizer should be applied annually.

Mulches of organic materials add nutrients to the soil on decomposition and may reduce the need for fertilizer. Sod around plants, on the other hand, increases the amount of fertilizer needed. Where a lawn grows beneath trees, fertilizer should be placed in holes about six inches deep spaced evenly beneath the spread of the branches. Manures may be used to supply part or all of the fertilizer requirements of plants.

Citrus trees are usually given an application of one pound of 8-8-8 fertilizer per year of tree age in February or March, with an application of one-quarter pound of nitrate of soda on one-year-old trees in June. The June application of nitrogen is increased to one-half pound on trees from two to four years of age. As the trees grow older this may be increased to maintain shoot growth at an adequate level.

Strawberries should receive about 8½ pounds of 6-12-6 fertilizer per hundred feet of row. At the usual spacing this amounts to about 850 pounds per acre. On heavy soils the application may be raised to 1,275 pounds per acre. It is applied in two applications, one-half mixed with the soil in the row two weeks before planting, the other as a side application just before the straw is applied in winter, usually in early January.

Grapes should receive a complete fertilizer during the first several years after planting. From one to two pounds of 8-8-8 fertilizer per vine is usually recommended, depending on the vigor of the vines. Too much vigor is no more desirable than too little. In general, shoots about pencil size are desired. Older vines seem to respond to nitrogen more than other elements except in special cases. One-half to one pound of nitrate of soda per vine is recommended when shoot growth is adequate. The amount may be gauged by the vigor of the vine.

Bramble fruits, such as blackberries and Ness berries, should be fertilized twice a season, at the time the trailing types are tied to stakes or trellises, usually in late February or early March, and at the time harvest is over. About one-half pound of an 8-8-8 fertilizer per plant at each application is recommended.

Blueberries have a greater requirement for iron than do most other plants. In addition, they are able to utilize the ammonium form of nitrogen more readily than the nitrate form. Both iron and ammonium nitrate are more available in acid soils than in those near neutral or alkaline. Too alkaline soil conditions usually cause chlorosis or yellowing of leaves and poor growth. For this reason ammonium sulfate, which leaves an acidifying residue, is commonly used as the nitrogen source for blueberries. Fertilizers sold for azaleas and camellias usually contain ammonium sulfate as the nitrogen source. From one to five pounds per plant should be applied annually, depending on the size of the plant.

Pruning

Pruning is necessary on all tree, bush, and vine fruits. In the early life of the plant pruning shapes it to make it stronger structurally and more efficient in later production of quality fruit. In the later life of the plant pruning helps to maintain vigor and to keep the leaf surface in the most favorable environment for productivity. The plant is kept to the size desired by pruning.

It is difficult to teach pruning without an actual demonstration, but some general principles can be outlined. Pruning is a dwarfing process which results in less total growth being made in the following season by pruned branches or whole trees compared to those not pruned. Use of this principle enables one to shape the plant by pruning branches which he desires to make less growth than others which are not pruned. Although pruning results in less total growth by the part that is pruned, the buds that grow from the remaining portion are usually invigorated and make larger shoots than buds on intact portions. Use of this fact enables one to maintain production of long, vigorous shoots on species which bear the crop on such shoots. Removal of dead, diseased, or unwanted branches is done by pruning.

Tools

If pruning is done regularly, most required cuts can be made with hand shears. Two main types are available: one that has a shearing action of two blades, and one that uses a blade that cuts against an anvil. Either is satisfactory, providing the blade is kept sharp.

Larger cuts may be needed for repair work or for rejuvenation of old trees. Saws made especially for pruning are available, but the home gardener can well use a common hand saw.

Protect Large Pruning Wounds

Large pruning cuts require several years to heal over completely, and the wood should be protected against entry of decay organisms and insects. A horticultural asphalt emulsion that is non-toxic to plants is recommended. Nursery outlets should be able to supply this material. Very large cuts that do not heal over for a long time may require renewal of the protective material from time to time.

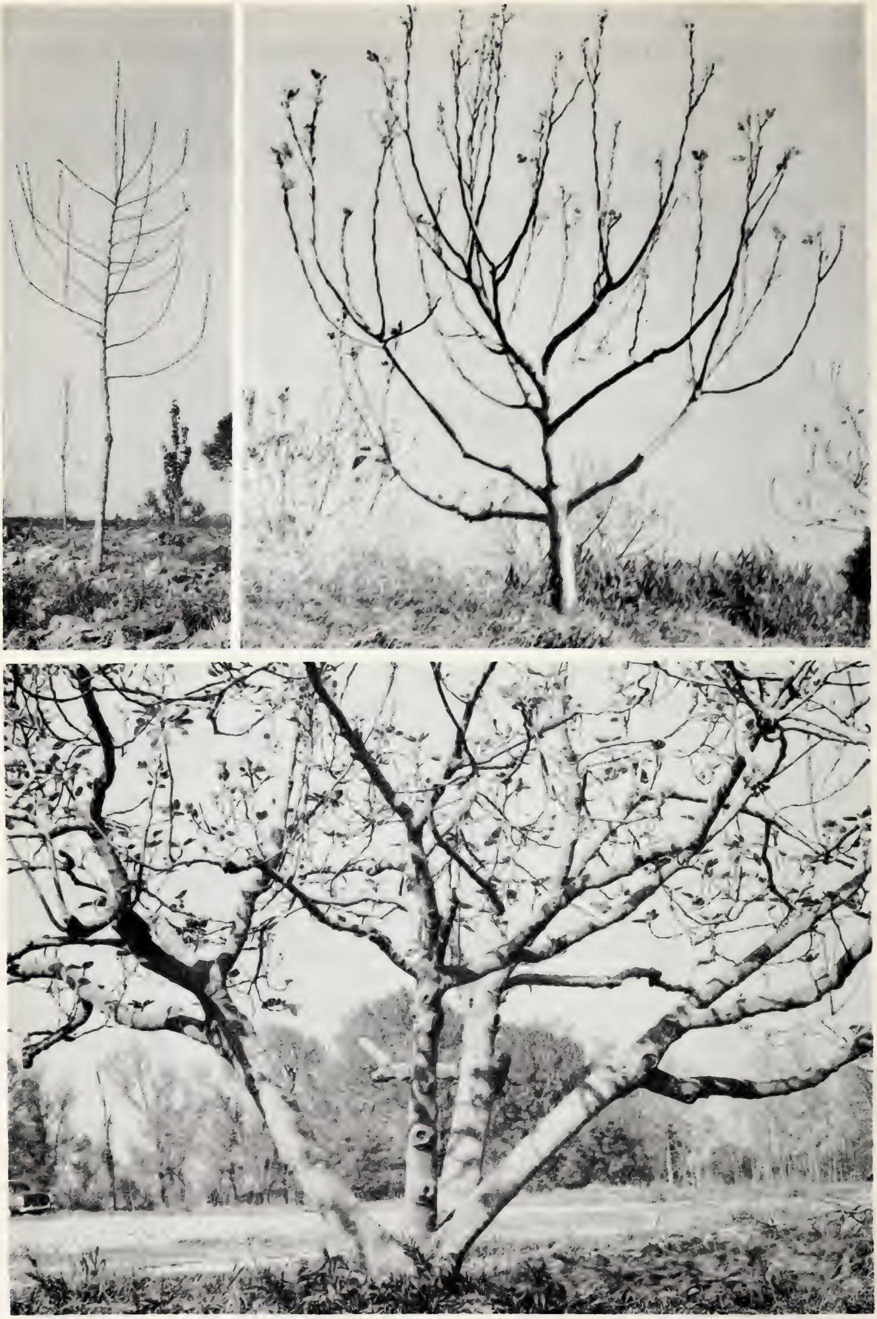
Tree Fruits Other Than Citrus

Prune to Shape Young Trees—Weak structure can be avoided by pruning during the formative years in the life of a tree. For example, narrow angles between the trunk and branches result in weak structure and are avoided by removal of young branches that grow at narrow angles in favor of those that form wider angles with the trunk.

Trees with multiple trunks arising from the same spot near the ground are prone to split apart during the most productive age of the tree. This structure can be avoided by keeping one upright branch dominant by pruning others. This results in a structure known as a "central leader." The leader, or single trunk, may be cut off after four or five branches form at the desired height, at which time the tree has a "modified central leader" structure. Apples, crab apples, pears, plums, and figs are usually pruned to a modified central leader, while peaches, nectarines, and some plums are usually pruned to a "vase" form.

In the vase system three or four branches spaced around the trunk make up the framework of the tree. The first branch should be about 18 inches from the ground and the others spaced three or four inches apart and arising from different sectors of the trunk to make a "vase" shape.

Nursery trees commonly have desirable branches when purchased, and these should be saved while others are removed. If the nursery tree has only weak lateral shoots, cut these back to leave two buds and cut the main central leader off at about 30 inches. When growth has started well from the remaining buds,



The shape of the fruit tree can be governed by pruning during the formative years in the life of the tree. Top left picture: young pear tree trained to a central leader. Top right: young fig tree trained to a modified central leader. Bottom picture: mature fig tree trained to a vase form.

select the shoots that are in the most desirable positions and remove others.

For the next two or three years little pruning is needed except for removal of badly crossing branches or those that grow too low to the ground. After the second or third year the main framework branches, or "scaffold" branches as they are called, should be cut back slightly to outward-growing lateral branches. This tends to open the center of the tree, which makes spraying, thinning, and harvesting easier and admits light to a greater portion of the tree.

Little pruning other than corrective pruning is necessary on young trees, and too much pruning will delay fruiting and favor shoot growth. Only corrective pruning or that which is done to shape the tree is desirable.

Prune to Maintain Production—After bearing age is attained, pruning will continue to be needed, but it will be somewhat different from that done to young trees. The height and spread of trees must be controlled by cutting back branches that are growing too high or too wide. Such cuts are almost always made to a lateral branch and are called "heading back" cuts. Small branches are removed from the inner, deeply shaded parts of the tree and from areas that are too dense. These are removed in entirety, and such cuts are called "thinning out" cuts. All cuts should be cleanly made, leaving no long stub. Such stubs are potential entry spots for fungi and insects. It is not desirable to cut so closely that an excessively large wound results.

Peaches and nectarines are borne along shoots made the previous year, and figs are borne along shoots produced in the same year. Terminal shoot growth of 12 to 18 inches a year is desirable for good production. A tree that grew at this rate each year would soon become too large for efficient production, and pruning is necessary to keep trees within bounds. Such a rate of growth is not maintained, however, in unpruned trees. The total number of shoots increases each year and the average size and vigor of the shoots decreases. Wood of the type found on old, unpruned trees produces fruit of poor size and poor quality. In order to maintain the production of vigorous shoots, pruning of a more extreme degree is done than in the case of apples and pears and fruits of the same type. Cuts on peaches are commonly made into two- and sometimes three-year-old branches, with the aim of stimulating the growth of vigorous shoots the following season. After the tree has been "headed back" to the desired extent, much of the small wood must be removed by "thinning out." Usually at least one-third of the previous year's shoots are removed each winter.

Citrus

Young Trees—Young citrus trees that are unbranched should be cut off to produce lateral branches about 12 to 18 inches above the ground. This facilitates covering the trunk and head with soil during the winter to prevent cold injury. Low-branching trees are also easier to spray and harvest. Citrus usually produces much quality fruit on low branches.

The framework of most species of citrus will develop satisfactorily without pruning, but any obvious defects should be corrected early. Upright growing trees like lemons and some oranges may need to be pruned much as other fruit species.

Bearing Trees—The principles that apply to citrus are the same as those that govern the pruning of other fruits. The tree must be made to conform to the desired space and height. The interior must be thinned out to allow light to reach inner branches, as these can produce much quality fruit. A gradual renewal of the fruiting area is accomplished by removing older, weaker branches in favor of younger, more vigorous branches.

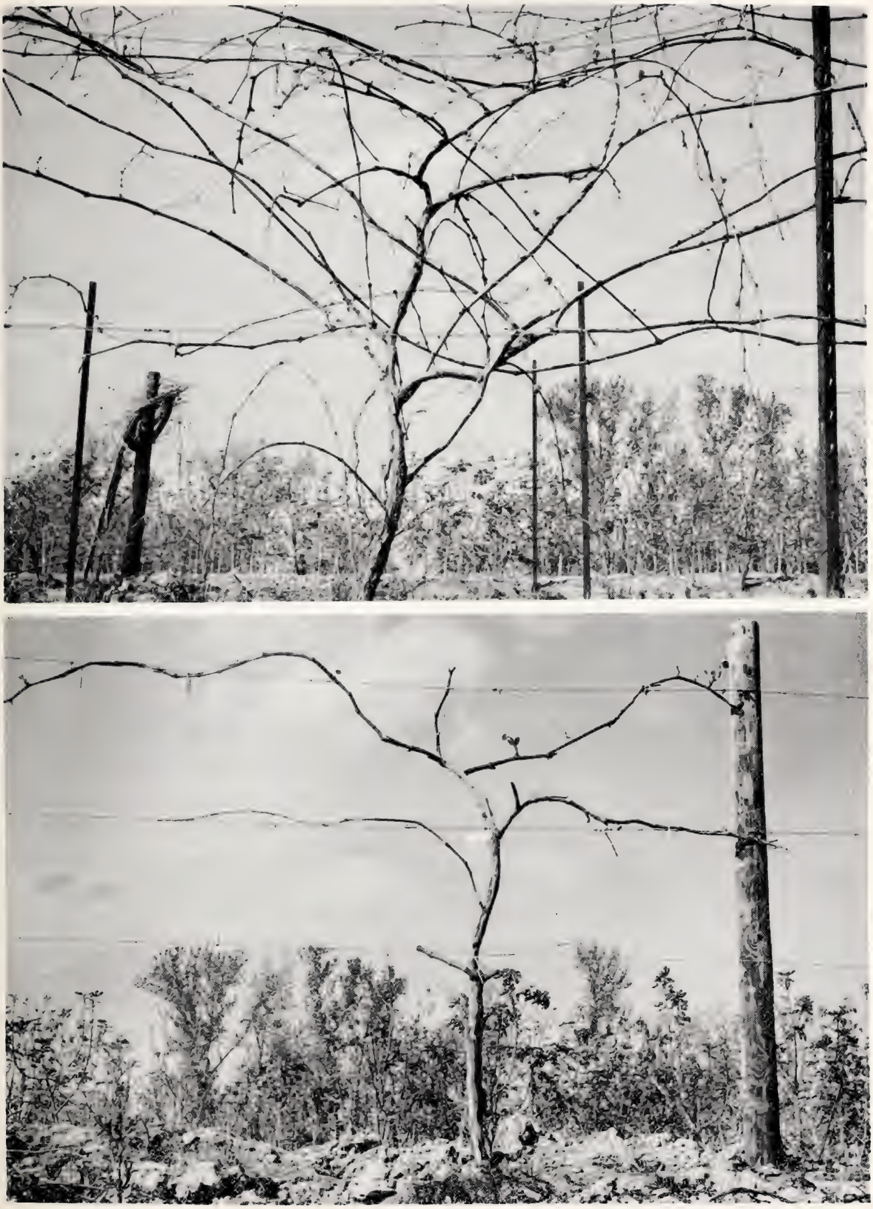
Frost- or Cold-Damaged Trees—Experience in major citrus areas has shown that cold-damaged trees should not be pruned for several months after the damage occurs. It is difficult to determine the extent of injury in most cases in less time than this. In addition, the result of cold injury is often to stimulate the production of too many vigorous shoots, and pruning severely can aggravate this tendency. Trees left unpruned for several months following cold injury have been shown to recover more rapidly than those pruned immediately.

Grapes

Grapes are pruned to a degree that shocks many amateur growers. The fruit is borne on shoots that are not yet in existence at the time of pruning, and the crop is influenced by the vigor of these shoots. If the shoots are too vigorous, the crop will suffer; on the other hand, if the shoots lack vigor, the crop will suffer. By pruning to leave the proper number of buds on the dormant vine, one can regulate the vigor of shoots produced from those buds. A vine that was very vigorous in the previous season is left with more buds than a less vigorous vine. This is called "balanced pruning."

The cultural system in which grapes will be grown influences the pruning to some extent. Most commercial grape plantings are trained to two-wire trellises, with the top wire six feet high and the lower wire three or four feet high. This is a good system for the home garden. In the first year after planting, the establishment of the trunk of the vine is the chief objective. At planting time the vine is usually cut back to leave two buds. The more vigorous shoot is selected and tied loosely to the two wires. The next spring, before growth starts, the second shoot may be removed, and the upright shoot can be cut off just below the top wire and securely fastened.

As lateral shoots arise from buds on the upright shoot, two should be selected to train along the bottom wire and two along the top wire. These shoots may branch in the first season or may merely form buds. In the second spring and thereafter, the vine is pruned



Top picture—Bunch grape before pruning. Bottom picture—Bunch grape after pruning to four-cane Kniffen system.

to the basic single-trunk, four-branch shape. Such a system of training is called the "single-stem, four-cane Kniffen system."

The amount of pruning should vary, depending upon the vigor of the vines. From 30 to 60 buds are left on most bunch grapes, but a vine vigorous enough to require 60 buds would have had about six pounds of prunings removed. Where grapes are allowed 10 to 12 feet of trellis space, 40 buds is about average for vines of moderate vigor.

The dormant shoots, or "canes" as they are called, should be about pencil-size in diameter, with six to eight inches between buds. Shoots that are too large are usually unproductive, and are called "bull" canes by commercial growers.

To keep the vines within the allotted area on the trellis, canes may need to be removed after several years in favor of newer canes that arise closer to the trunk. Shoots that arise near the trunk may be cut to two buds the season before they are to be used and one of the resulting canes selected the next spring as the fruiting cane.

Where vines are grown on arbors, the same principles of pruning are applied, but usually more canes are left in positions to cover the arbor. The pruning should still be balanced to the vigor of the vine.

Muscadine grapes are trained in the same system as bunch grapes or may be grown on arbors. The one-year-old shoots are cut back each year to two or three buds. After several years some thinning out of canes will be necessary to prevent crowding and shading.

Brambles

Fruits are produced on two-year-old shoots, or "canes," which die after fruiting. These are of no further use, and are commonly diseased. In order to facilitate removal of old canes and to keep diseases in check, the bramble planting should be cut back following fruiting and all canes and leaves should be raked up and burned. The shoots that will bear the next year's crop will then grow throughout the remainder of the season.

Blackberries of the upright-growing type may be made more self-supporting and compact by pinching out the tips of the new shoots when they attain 18 to 24 inches length. This causes the lateral buds to grow out into branches. Trailing blackberries, such as the Boysenberry, are usually allowed to grow along the ground until early spring, when the fruiting canes are gathered and tied to stakes. After harvest is over, the stakes are removed and the canes cut off and burned.

Blueberries

Old, bearing blueberry plants often become too dense. Pruning is necessary to thin out such plants. New, strong shoots are desired for the best crop production, and old, weak branches that are not productive can be removed in favor of younger branches.

Control of Diseases and Insects

It is beyond the scope of this publication to make specific recommendations for the control of diseases and insects. Several publications now in print cover this field.*

In general, however, almost all fruits require control of diseases and insects for best performance. A few which will succeed fairly well with no control program are: figs, loquats, muscadine grapes, persimmons, guavas, scab-resistant pecan seedlings, and blueberries.

Diseases usually attack the leaves, framework, roots, or fruit of plants. Most common fruit diseases are caused by fungi, with several notable exceptions such as fireblight of pears and related fruits, which is a bacterial disease.

Insects that attack fruit plants are of two general types, chewing insects and sucking insects. The chewing insects can often be controlled by covering plant parts with poisonous residues that kill the insect on being eaten.

Sucking insects are usually controlled by sprays that kill by contacting the bodies of the insects. Both types are sometimes controlled by materials that kill the eggs or immature stages.

Spraying is a chore all gardeners would make as easy as possible. A combination spray that will control both types of insects and most plant diseases has long been desired. One mixture that serves to answer this requirement is the following:†

Methoxychlor, 50% wettable powder	2 Tbsp.	per	gallon
Malathion, 50% emulsion	2 Tbsp.	"	"
or			
25% wettable powder	2 Tbsp.	"	"
Dithane Z78	2 Tbsp.	"	"
or			
Captan, 50% wettable powder	2 Tbsp.	"	"

A wetting agent such as a liquid detergent should be added to the tank after the materials are mixed. This will insure wetting the plant surfaces.

---

*A recent publication is: *Diseases of Some Vegetable and Fruit Crops and Their Control.* A. G. Plakidas. Bulletin 357 (revised June, 1957), La. Agr. Exp. Sta.

†There are numerous recommendations for all-purpose sprays which have been published by state experiment stations. One recent publication is: *Pest Control Program for Home Grown Fruit.* Michigan State Univ. Extension Folder F-117 (revised). June, 1958.

Many insects and insect eggs are found on the lower surfaces of leaves, and care must be taken to cover these areas.

Many fruit trees are attacked by scale insects that cover themselves with impervious shells. An effective control is to use a spray of emulsified oil in water. A 4 per cent oil in water mixture is used on most dormant plants. Oil sprays are used on deciduous trees while they are dormant, and on evergreens, such as citrus, at times when the leaves are most resistant to damage by the oil. Young leaves can be severely injured by oil sprays.

Fruit Thinning

Most fruit trees produce more fruit than the tree can properly mature. Overproduction results in small, poor fruits and can cause the plant to fail to bloom enough for a full crop the following season. Many fruits, especially those with few seeds, normally drop from the plant soon after fruit set and result in what is called "June drop" in many fruit areas. This usually is not enough thinning to produce the desirable type of fruit.

Peaches and plums are notorious over-producers and should be hand-thinned following the June drop. Peaches are usually left no closer than four inches apart and plums are left two inches apart. No fruits should be so close as to touch, as this makes it difficult to cover the fruits properly with insecticides and fungicides, and encourages fruit rots.

Apples and pears should be thinned to six inches apart where they set too heavily. Pears often set so much fruit that the weight results in limb breakage. Apples do not usually need thinning as often as pears.

Small fruits are not usually thinned.

Harvesting

Where fruit is grown for home use it is usually desirable to leave fruit on the tree until it is fully mature. Both size and quality increase greatly in many fruits after the stage when most commercial fruit growers must harvest. An exception is noted in the case of pears; they should be picked as soon as the green color begins to turn yellow and should be kept in a cool place, preferably between 60 and 65 degrees Fahrenheit, until they soften. Most pears attain the best quality when handled in this way. Varieties with oriental heritage become gritty if allowed to ripen on the tree.

Winter Protection

Winter injury consists of two main types of damage: that to flowers in spring, with the resulting loss of part or all of the crop, and that to trunk or limbs of the tree during periods of low temperatures.

The selection of varieties to aid in avoiding winter injury has been discussed. In addition it has been noted in the section on varieties that some are more resistant to tissue damage by low temperatures than are others.

The planting site can contribute to winter protection. Air drainage, which allows the denser, colder air to drain from the planting, aids materially. In some locations windbreaks, consisting of a row of high trees to the north of the fruit planting, can be of great value.

A tree in good condition is less subject to injury from cold, and good cultural practices can contribute to the prevention of some cold damage.

SUGGESTED REFERENCES

The Fundamentals of Fruit Production (2nd ed.). V. R. Gardner, F. C. Bradford, and H. D. Hooker, Jr. McGraw-Hill Book Company, Inc., New York. 1939.

Deciduous Orchards (3rd ed.). W. H. Chandler. Lea & Febiger, Philadelphia. 1957.

Evergreen Orchards (2nd. ed.). W. H. Chandler. Lea & Febiger, Philadelphia. 1958.

TECHNOLOGY AND SCIENCE ROOM

LETIN NO. 532

MAY 1960

RATOON STUNTING DISEASE OF SUGARCANE

I. L. FORBES, R. J. STEIB, S. J. P. CHILTON

ricultural Experiment Station
Charles W. Upp, Director

Louisiana State University and
Agricultural and Mechanical College

CONTENTS

Page

Introduction . . . 3
Historical . . . 3
Symptoms and Identification of the Disease . . . 3
Cause and Transmission . . . 4
Dissemination . . . 4
Host Range . . . 4
Varietal Resistance . . . 5
Yield Responses to Disease Control . . . 5
    Results With Present Commercial Varieties . . . 6
    Results With Former Commercial Varieties . . . 9
Studies on Control and Rate of Increase of the Disease In Hot-Air Treated Cane . . . 14
Recommendations for Control of Ratoon Stunting Disease in Louisiana by the Hot-Air Treatment of Seed Cane . . . 17
    Operation of Electric Hot-Air Oven . . . 17
    Planting, Cultivating, and Harvesting Treated Cane . . . 19
Hot Water As a Control for Ratoon Stunting Disease . . . 20
Addenda . . . 21
Literature Cited . . . 22

THE COVER—Picture on the cover shows placement of seed cane in racks which fit into the hot-air oven.

Ratoon Stunting Disease of Sugarcane

I. L. Forbes, R. J. Steib, and S. J. P. Chilton

Introduction

Sugarcane diseases have been responsible for the deterioration or "running out" of varieties in Louisiana through the years. The most precipitous failure of the sugar industry occurred in the decade 1920-1930. The lowest yield, 47,000 tons of sugar in 1926, was about one-tenth of the potential production from the acreage in cane at that time. The failure was variously attributed to mosaic, root rot complex, and red rot. Some researchers, however, assumed that there were perhaps other diseases involved in the crop failures. The ratoon stunting disease (R.S.D.) was first reported in Louisiana in 1953 (2).[1] The likelihood is that the disease had been present in Louisiana for many years, and it is entirely possible that the failure of the industry in the 1920's was due in part to this insidious virus disease.

Historical

The name "ratoon stunting disease" first appeared in print in 1949 in Queensland, Australia, although Hughes and Steindl had used the terminology there during the previous year. The trouble had been under investigation in Australia for several years and since it appeared to be confined to the variety Q. 28, the terms "Q. 28 trouble" or "Q. 28 disease" came into common use among farmers and investigating officers alike. It was not until 1949, however, that the Australian scientists had sufficient information to state that the "ratoon stunting disease" was due to a transmissible disease. The discovery that a hot-water treatment rendered seed pieces disease-free made it possible for the Australians to initiate full control measures against the disease.

Since 1953, the year in which the ratoon stunting disease was first reported in Louisiana by Abbott (2), a great deal of research on the disease has been conducted by both the U.S.D.A. Station at Houma and the Louisiana Agricultural Experiment Station at Baton Rouge.

Symptoms and Identification of the Disease

The external symptoms of the disease are stunting and reduced vigor of plants and stiffness and abnormal rolling of leaves in very dry weather. However, since such visible symptoms can be caused by many different factors in the environment, this alone is not of sufficient value in makin a positive diagnosis of the stunting disease. The internal symptom consist of an orange to reddish discoloration in the vascular tissue a certain points at the base of the nodes of mature stalks and a genera pink color in the growing point of small shoots. These are the symptom most relied upon in making a positive identification of the disease.

---

[1] Numbers in parentheses refer to Literature Cited, pages 22-23.

Cause and Transmission

The fact that no microbial causal agent of ratoon stunting diseas has been isolated, together with the fact that the disease is juice transmissible from diseased to healthy plants, is considered as sufficien evidence to classify the causal agent as a virus. Additional evidence o the viral nature of the causative agent is the fact that it can be destroyed by heating the sugarcane seed pieces to about 54° C. inside th stalk. This temperature controls the disease but does not destroy th buds on the seed pieces.

The cutting knife is considered to be the principal means of transmission of the disease from diseased to healthy plants. No insect vectors have been reported to date.

Dissemination

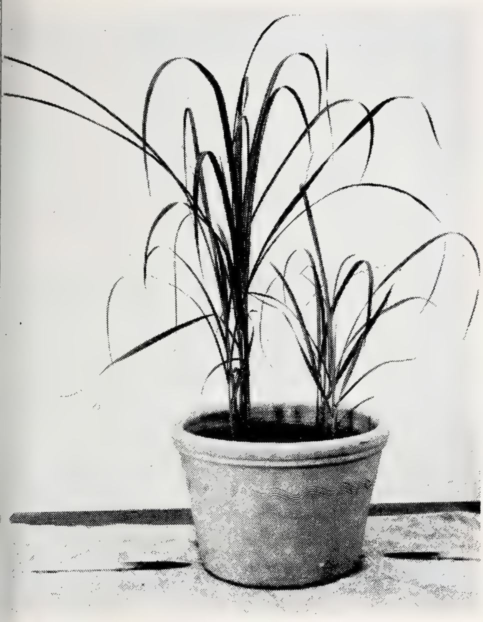
The disease is spread from one part of a field to another or fro one locality to another through the use of diseased seed cane, or by harvesting a field of cane with cane knives or harvesters contaminated with the virus causing the disease.

Host Range

Plants, other than sugarcane, naturally infected with ratoon stunting disease have not been recognized in the field. However, successful inoculation of other plants has been made. In 1955, Hughes (10) in Australia reported results of inoculation tests on corn and sweet sorghum. Extracts from the inoculated plants proved infective when inoculated into the sugarcane variety Q. 28. In 1957 Steindl (20) in Australia reported successful inoculations in the following genera of grasses: *Brachiaria, Chloris, Cynodon, Echinochloa, Imperata, Panicum, Rhynchelytrum, Sorghum,* and *Sporobolus.* Sugarcane plants became infected when inoculated with juice from these grasses. In 1957, Steib and Forbes (18) reported successful inoculation of corn and Johnson grass (*Sorghum halepense*). No symptoms developed, but juice from inoculated plants produced the disease when inoculated into the sugarcane variety C.P. 44-101.

Varietal Resistance

In resistance ratings varieties vary from highly susceptible to highly resistant. Whether or not any variety is immune is not known. Resistance is measured by decreases in yield and by the percentage of natural infection occurring in the field. Losses have been measured experimentally by comparing yields from plots grown from diseased seed cane with ones planted with healthy seed pieces (usually the progeny crop from heat-treated seed cane).



C.P. 44-101, in steam-sterilized soil, 75 days old. Healthy on left, ratoon stunting diseased on right.

A few varieties are considered to be resistant, many more are classed as susceptible, while many others are apparently intermediate in resistance. Varieties rated as resistant include: Badila, C.P. 29-116, Comus, S.J. 16, Q. 57, Q. 50, Ebene 1/37, B. 34-104, and B. 37-161. Varieties considered highly susceptible are: Q. 28, Q. 66, Q. 47, S.J. 4, Pindar, Trojan, Vidar, P.O.J. 2878, N.Co. 310, M. 34/132 (Mauritius), B. 3337, B. 37172, C.P. 28-19, C.P. 34-120, C.P. 36-105, C.P. 43-47, C.P. 44-101, F. 108, P.O.J. 2883, and Co. 281. Definite information on many other common world varieties is lacking (9).

Yield Responses to Disease Control

The effects of ratoon stunting disease on yields of important commercial varieties, presently and formerly grown in Louisiana, were determined by a series of yield trials begun in 1953. These studies were initiated immediately after the disease was found in Louisiana. Before recommendations could be made to the Louisiana sugar industry with respect to steps to be taken to control the disease, it was felt that information should be in hand regarding the reaction of the different varieties to hot-water and hot-air treatments (13, 15, 17).

Seed cane of all the commercial varieties being grown on the Louisiana Agricultural Experiment Station was subjected to various hot-wate and hot-air treatments, and effects of the treatments were determined b comparing the germination of the treated with the nontreated cane These tests were useful also in providing disease-free seed cane whic would be used in comparative yield trials. By the fall of 1953 enoug seed cane of varieties presently grown and some of those formerly grow was available to provide an ample supply of progeny seed for yiel trials the next year. Seed cane of varieties found to be diseased was als increased in 1953. This provided diseased seed for yield trials planne for the fall of 1954. Yield trials were made also in 1955, 1956, and 1957

The yields in tons of cane per acre, of diseased and disease-free cane were calculated, after the appropriate trash deductions were made, fro the gross cane weights obtained from four replicated plots. The suga per ton of cane determinations were made by crushing 5-stalk sample from each of the four replications in the test. The various samples wer crushed in a small hand mill, and brix, sucrose,[2] and purity determinations were made for each sample. The average sucrose content of the fou samples from diseased and disease-free cane was used as the basis fo determining the sugar recoverable per ton of cane. Yield of sugar pe acre was calculated by multiplying the net tons of cane per acre by th sugar per ton of cane.

Results with Present Commercial Varieties

Results of the first yield trials, harvested in 1955, and those harvested each year thereafter through 1958, for the varieties being grown in Louisiana are given in Table 1. The results of a large number of tests for the two leading commercial varieties, C.P. 44-101 and C.P. 36-105, are also given in Table 1. Other varieties included in the tests which are grown only on a limited acreage but are important in certain areas of the state, were C.P. 44-155, C.P. 43-47, C.P. 48-103, and C.P. 47-193. Seed cane for planting diseased plots was from a crop grown from stalks that had been inoculated with ratoon stunting disease.

An analysis of yields obtained during the four-year test shows that the disease was causing serious losses in all the important commercial varieties grown in Louisiana. The increase in tons per acre in the plant cane and first ratoon due to the elimination of the disease by the hot-air treatment of seed cane clearly demonstrated why there had been a gradual decline in yield of the two leading varieties being grown in Louisiana at that time. It was found that elimination of the ratoon stunting disease increased the yield of the leading variety, C.P. 44-101, which was being grown on more than 50 per cent of the acreage, by 7.8 tons of cane per acre, or 33.6 per cent, and by 15.4 tons, or 86.0 per cent, for plant cane and first ratoon, respectively. The average increase for the two crops was 11.6 tons per acre, or 59.8 per cent. The other important variety, C.P. 36-105, grown on 15 per cent of the acreage, also gave marked increases in yield in both the plant cane and in the first ratoon crop. The increase in the plant cane was 7.3 tons per acre, or 28.4 per cent, while the first ratoon responded with an increase of 12.6 tons per acre, or 62.7 per cent. The average increase for the two crops was 10.0 tons per acre, or 45.6 per cent.

---

[2] Sucrose analysis by the Horn's dry lead method.

Presently grown varieties of lesser importance also gave significant increases in yield of cane per acre when freed of the disease. Two of the remaining four varieties have been released for a number of years but have never occupied a very large acreage. The two varieties are C.P. 43-47

TABLE 1.—Increases in Yield of Cane and Sugar per Acre Due to Control of Ratoon Stunting Disease, by Hot Air, in Varieties of Sugarcane Presently Grown in Louisiana

Type of Cane	No.	Increase in Cane Yield		Increase in Sugar	
	Tests	Tons/A.	Per Cent	Lbs./A.	Per Cent
C.P. 36-105					
Plant cane	14	7.3	28.4	1,117	27.1
1st Ratoon	7	12.6	62.7	2,142	64.2
Average		10.0	45.6	1,630	45.7
C.P. 43-47					
Plant cane	2	7.1	26.5	841	22.5
1st Ratoon	1	11.1	48.1	931	30.3
Average		9.1	37.3	886	26.4
C.P. 44-101					
Plant cane	17	7.8	33.6	765	21.2
1st Ratoon	9	15.4	86.6	1,923	65.6
Average		11.6	59.8	1,344	43.4
C.P. 44-155					
Plant cane	2	7.9	27.9	543	12.7
1st Ratoon	1	13.6	74.3	1,474	48.7
Average		10.8	51.1	1,008	30.7
C.P. 47-193					
Plant cane	3	3.8	13.0	670	15.5
1st Ratoon	2	7.7	33.6	1,748	47.6
Average		5.7	23.3	1,209	31.6
C.P. 48-103					
Plant cane	3	4.5	17.6	633	14.4
1st Ratoon	2	10.5	64.8	897	58.5
Average		7.5	41.2	765	36.5

and C.P. 44-155. It was found that the disease-free plant cane and firs ratoon of these two varieties also gave significant increases in yield o cane over the diseased cane. The results are shown in Table 1. A simila response was found with varieties C.P. 47-193 and C.P. 48-103, whic were released for commercial production within the last few years C.P. 48-103, a very early maturing variety, is considered an importan addition to the varietal picture in Louisiana. A big disadvantage of th variety is the relatively poor yield per acre, especially in the ratoo crops. The yield increases obtained as a result of eliminating the ratoo stunting disease suggest that the variety will be more widely accepte than was formerly anticipated.

The data clearly show that a greater increase in yield was obtaine in the first ratoon crop than in the plant cane. Table 2 gives the effect of the disease on the yield for a number of important commercial varieties now being grown in Louisiana. (Highly significant increases in yield were obtained also from many present and former commercial varietie by Schexnayder and Abbott (14) when the disease was eliminated by a heat treatment. Their results showed that the first ratoon crop of all the varieties tested maintained a high level of production when the disease was not present.) As shown in Table 2, yields of the disease-free ratoon for the two leading commercial varieties, C.P. 44-101 and C.P. 36-105, and also C.P. 43-47, were as high as those of the disease-free plant cane. The diseased canes, however, showed a very great reduction in yield in the first ratoon. First ratoon yields of other varieties free of the disease, given in Table 2, were not as high as yields of disease-free plant cane. The results indicate, however, that there would be no appreciable reduction in yield from plant cane to the first ratoon if the important varieties now grown in Louisiana were free of the ratoon stunting disease.

TABLE 2.—Effects of the Ratoon Stunting Disease on Yields of the Plant Cane and First Ratoon of Important Commercial Sugarcane Varieties Presently Grown in Louisiana

	Yields in Tons Per Acre					
Type of Cane	C.P. 36-105	C.P. 44-101	C.P. 43-47	C.P. 44-155	C.P. 47-193	C.P. 48-103
Plant cane						
Disease-free	33.0	31.0	33.9	36.2	33.0	30.1
Diseased	25.7	23.2	26.8	28.3	29.2	25.6
1st Ratoon						
Disease-free	32.7	33.3	34.2	31.9	30.6	26.7
Diseased	20.1	17.9	23.1	18.3	22.9	16.2

Results with Former Commercial Varieties

The effects of ratoon stunting disease on yields of varieties formerly grown in Louisiana were also determined. Harvesting procedures and sucrose determinations were the same as those outlined for the tests previously discussed.

The effects of the disease on yields of cane and sugar for each variety included in a series of tests conducted over a four-year period (1955-1958) are shown in Table 3.

The response following elimination of ratoon stunting disease is similar to the response obtained with varieties being grown in Louisiana at present. Significant increases in yield were noted for all varieties included in the tests, except C.P. 29-116. The greatest percentage increases for the two crops were obtained with varieties C.P. 28-19 and Co. 281.

Healthy cane on right, ratoon stunting diseased on left.

TABLE 3.—Increases in Yield of Cane and Sugar per Acre Due to Control of Ratoon Stunting Disease in Former Leading Commercial Varieties of Sugarcane in Louisiana

Type of Cane	No.	Increase in Cane Yield		Increase in Sugar	
	Tests	Tons/A.	Per Cent	Lbs./A.	Per Cent
C.P. 28-19					
Plant cane	4	4.1	16.3	179	5.0
1st Ratoon	3	11.6	85.3	1,855	76.0
Average		7.9	51.1	1,017	40.5
C.P. 29-116					
Plant cane	3	–3.5	–11.6	– 437	–12.4
1st Ratoon	3	4.0	16.5	672	20.4
Average		.3	2.5	117	4.0
C.P. 29-320					
Plant cane	6	4.8	18.6	540	15.0
1st Ratoon	4	4.8	24.9	599	18.7
Average		4.8	21.8	570	16.9
C.P. 34-120					
Plant cane	5	3.5	12.3	291	9.0
1st Ratoon	5	5.4	20.0	504	12.3
Average		4.5	16.2	397	10.7
C.P. 36-13					
Plant cane	3	5.2	16.3	159	3.4
1st Ratoon	2	5.8	25.8	623	18.8
Average		5.5	21.1	391	11.1
Co. 290					
Plant cane	7	5.8	18.0	371	10.5
1st Ratoon	6	8.9	36.5	1,193	38.0
Average		7.4	27.3	782	24.3
Co. 281					
Plant cane	4	10.0	44.2	609	24.1
1st Ratoon	3	6.6	41.3	872	43.7
Average		8.3	42.8	741	33.9
P.O.J. 213					
Plant cane	2	2.9	13.6	244	11.1
1st Ratoon	1	6.1	44.9	595	31.2
Average		4.7	29.3	420	21.2

There was a slight depression in sugar per ton of cane for the average of both crops of all varieties in the tests. As was the case for the varieties presently grown, this reduction in sugar content is not considered significant because of the great increase in yield of cane.

Results of these yield trials suggest that ratoon stunting disease played an important part in the deterioration of many of the C.P. and Co. varieties once favored in Louisiana. Although comparative yield results are available for only one P.O.J. variety, P.O.J. 213, indications are that all the P.O.J. varieties were probably affected by the disease.

Results published by Denley (7) showed that the average yield of P.O.J. 213 in the plant and first ratoon crops was 25.9 tons per acre in 1929; however, by 1934, the average yield for the two crops had declined to 14.0 tons per acre. The author stated that all the P.O.J. varieties introduced into Louisiana appeared free of disease, but within a relatively short period of time, gradual decline in yield was noted, and by 1934 the yields were approximately one-half of the 1928 and 1929 yields. It was also observed that the decline was especially drastic in the ratoon crops, and unusually favorable weather conditions in some years appeared to arrest the decline. Abbott (1) concluded, after extensive study of the light and dark strains of the red rot fungus, that the light strain was responsible for the failure of P.O.J. 213 in Louisiana and in the sirup-producing states. Ratoon deterioration studies by Edgerton (8) suggested root rot, red rot, and possibly a number of other diseases caused the rapid decline in yield of the P.O.J. varieties. Data collected from a number of outfield test plots located in the sugar belt of Louisiana and published by Arceneaux and others (3) also showed a downward trend in the yielding capacity of P.O.J. 213 from 1928 to 1934 (Table 4).

In an attempt to determine whether or not ratoon stunting disease contributed to this decline, P.O.J. 213 was included in the yield trials at the Louisiana Agricultural Experiment Station beginning in 1954. Since no mosaic-free P.O.J. 213 was available at the time, mosaic-diseased cane free of ratoon stunting disease was planted in comparison with seed having both diseases. Results of trials conducted in 1955, 1956, and 1958 showed that the average yield for the plant and first ratoon crops for cane free of the ratoon stunting disease, but with mosaic, was 22.0 tons per acre. When this figure is compared with the 14.0 tons per acre figure of 1934, it is apparent that even with mosaic present, there was a substantial increase in yield when ratoon stunting disease was eliminated. Because of the presence of mosaic, red rot, and root rot, the 22.0 tons yield was 8.0 tons short of the top yield produced by the variety in 1928 when it was considered free of disease. These results indicated that the

TABLE 4.—Comparison of Yields from the U.S.D.A. Test Fields in Louisiana from 1930 to 1950, Inclusive, with Yields of the Same Varieties Free of the Ratoon Stunting Disease

Crop Year	Co. 281	Co. 290	C.P. 28-19	C.P. 29-320	C.P. 29-116	C.P. 31-120
	Tons per Acre — Av. Plant Cane and 1st Ratoon					
1930-31	22.8					
1931-32	23.8	32.2				
1932-33	22.3	33.9				
1933-34	19.3	31.4	22.6			
1934-35	22.2	34.7	24.8			
1935-36	23.0	36.4	24.7			
1936-37	21.9	33.5	23.6	26.5	32.8	
1937-38	20.4	36.2	23.7	27.2	36.5	
1938-39	21.1	35.2	23.0	25.7	35.2	
1939-40	20.7	22.7	18.6	20.3	32.3	
1940-41	14.0	23.3	15.7	14.3	24.6	
1941-42	18.3	26.6	20.0	18.3	28.2	28.2
1942-43	19.7	28.8	19.7	21.1	31.4	30.6
1943-44	16.9	27.9	17.2	19.5	33.0	29.4
1944-45	16.4	32.4	17.7	21.0	30.0	30.1
1945-46	17.6	29.2	16.7	18.9	28.7	26.7
1946-47	13.0	20.3	12.7	13.8	21.4	17.4
1947-48	. .	18.2	.	13.5	21.4	16.4
1948-49	. .	26.1	.	17.7	25.8	21.1
1949-50		26.6		18.6	26.4	22.0
Disease-free	26.9	35.7	27.2	27.4	29.2	32.2
No. tests	7	13	7	10	6	10
Diseased (RSD)	18.6	28.4	19.4	22.6	28.9	27.8
No. tests	7	13	7	10	6	10

					Year				
P.O.J. 213	'26	'27	'28	'29	'30	'31	'32	'33	'34
Pl. cane	20.6	24.5	31.3	30.3	24.4	21.8	20.1	20.2	
1st Ratoon		23.5	28.7	31.6	26.4	18.5	19.4	17.7	14.3
Average	20.6	24.0	30.0	31.0	25.4	20.2	19.8	19.0	14.3

rather quick decline of P.O.J. 213 was probably due to several diseases, ratoon stunting disease being one of the most important.

In an attempt to evaluate the yields of different varieties in Louisiana, Arceneaux and Hebert (4) made a statistical analysis of yield data at four test fields during the period 1937-40. The authors stated that the most interesting disclosure brought out by the analysis of the data was a progressive change in the relative performance of the different varieties. Of the six varieties grown at the four test stations, namely, Co. 281, Co. 290, C.P. 28-11, C.P. 28-19, C.P. 29-116, and C.P. 29-320, only

C.P. 29-116 performed uniformly. It was suggested that the negative regression in varietal yield as compared to C.P. 29-116 probably represented a decrease in varietal yield capacity resulting from the encroachment of a disease or diseases on the clone. The change in yield status displayed by some varieties at different stations, according to the authors, was probably due to a rare and specifically virulent strain of a given disease organism which was not present in the same proportion at all stations or was entirely absent at some places.

In an attempt to explain this gradual deterioration of the above mentioned varieties, scientists of the two main research stations in Louisiana conducted disease investigations over a period of years (1, 8, 16, 11, 12, 21). The evidence presented and reasons given for this failure were never conclusive. The discovery of the ratoon stunting disease in Australia by Steindl (19) may serve to explain such failures, which have been accepted as a matter of fact in Louisiana and in many other countries.

The test field performance of several sugarcane varieties formerly grown on a large scale in Louisiana was published by Arceneaux and others (3, 9, 18, 20) covering the period from 1930 to 1950, inclusive. Table 4 gives the yield of cane per acre for the plant cane and first ratoon from the time they were released for commercial production through the 1949-50 crop year. From the data presented, a comparison may be made of the highest and lowest yields of each variety, with the yields obtained from the same varieties with and without the ratoon stunting disease. Results taken during the yield trials showed that yields of disease-free cane were as high as, or higher than, the highest tonnage for each variety, except C.P. 29-116. With this variety, the drop in yield from the record of 36.5 tons produced by the cane free of the ratoon stunting disease to 29.2 tons was probably due to diseases not controlled by the hot-air treatment, or to other factors, since there were no significant differences in yield between cane with and without ratoon stunting disease. The mechanization of farming operations in Louisiana in the forties probably affected the yielding capacity of this variety since it is a very recumbent cane.

The results reported show very clearly that ratoon stunting disease is playing an important part in reducing the yield of the varieties presently grown, and also indicate that it was probably responsible for the "running out" of a number of varieties formerly grown in Louisiana. It was found that the yield of both the plant and first ratoon crops could be restored to a very high level by elimination of the disease. For some varieties now grown on a large scale, the yields produced by the healthy first ratoon crop were as high as those of the healthy plant cane.

The most striking differences in yield were between ratoon crops of varieties with and without the disease, indicating that the greatest losses occur in the ratoon crops. It may be concluded that ratoon stunting disease is causing serious losses in yield of sugarcane in Louisiana, and that, upon elimination of the malady, the varieties presently grown should regain and maintain a high level of production in both the plant cane and ratoon crops, providing other serious diseases, such as mosaic, are also kept under control.

Studies on Control and Rate of Increase of the Disease in Hot-Air Treated Cane

Following the discovery of the ratoon stunting disease in Louisiana in 1953, studies were begun at the Louisiana Agricultural Experiment Station at Baton Rouge and at the U.S.D.A. Station at Houma, Louisiana, to determine the reaction of commercial varieties and promising unreleased seedlings to the hot-water and hot-air treatments. Study of the rate of spread of the disease as a result of mechanical harvesting was also initiated.

Results of these tests showed that cane treated when 7 to 8 months old was severely injured by the hot-water but not by the hot-air treatment. The Ratoon Stunting Disease Committee, composed of members of both stations and of the American Sugar Cane League, upon receiving the reports of the scientists, recommended the use of the hot-air treatment in Louisiana. Other factors considered in arriving at this recommendation were: (1) In Louisiana, there is no readily available source of steam to heat the water, as in the tropics, because the heating and planting of the crop commence before the factories are in operation; (2) gas and electricity, which are available on practically every farm in the sugar belt, could be used as a source of heat for the hot-air treatment; (3) temperature control is not as critical with air as with hot-water in treating immature cane; and (4) farmers would be able to purchase an oven built according to specifications.

Seed cane was treated on a commercial scale for the first time in the fall of 1955. Treatment requires that the ingoing air be heated to 58° C. or 59° C., depending on the variety. An oven temperature of 54° C. is reached in about 3 hours after the treatment commences, and it requires 5 more hours at this temperature to eliminate the virus from the seed piece. The cane is planted as soon as possible after it is removed from the oven.

Studies were made in the spring of 1956, and repeated in 1957 and 1958, to determine the effects of the treatment on stands, degree of control obtained, and rate of increase of the disease in the progenies of treated cane which had been cut by a mechanical harvester.

Because examinations were made in the spring when the growing point of the primary shoot was still under the ground, the pink discoloration in the growing point, associated with the disease, was used to determine the presence of the disease. This method of identification was found very reliable, in some ways more so than the reddish-orange color of the fibrovascular bundles associated with the disease in mature stalks.

Table 5 gives a summary of the degree of control and rate of increase of the disease in plant cane and first ratoon crops grown from heat-treated seed cane. Information was obtained from spring surveys in 1956, 1957, and 1958. Varieties used were C.P. 44-101, C.P. 36-105, and C.P. 43-47. Disease readings were made on progenies grown from seed one year removed from heat-treated seed cane. The percentage disease was determined in the plant cane crop, in the first ratoon of that crop, and in a crop grown from seed obtained from the plant cane crop. This was done in order to determine the rate of spread of the disease as a result of one cutting with the mechanical harvester.

The 21 lots of C.P. 44-101 plant cane treated in the fall of 1955 and 1956 and planted on 21 different plantations were found to be 5.4 per cent diseased. An examination of the plant cane progeny from heat-treated cane from the same 21 lots the next year showed that the disease had increased to 21.2 per cent. The first ratoon grown from the same 21 lots of treated cane was 15.6 per cent diseased after only one cutting with the mechanical harvester. A similar examination of treated C.P. 36-105 and C.P. 43-47 showed that the amount of disease left in the cane following the hot-air treatment was 2.3 and 4.2 per cent, respectively. An examination in the spring, of plant cane grown from treated seed which had been replanted, showed that the disease had increased to 12.5 per cent for C.P. 36-105 and to 23.0 per cent for C.P. 43-47. The first ratoon grown from the treated plant cane was found to have increased to 14.3 per cent for C.P. 36-105 and to 28.6 per cent for C.P. 43-47.

The amount of disease found in the oven-treated plant cane of the three varieties averaged 4.5 per cent. An examination of the plant cane of the three varieties grown from treated cane which had been replanted and the first ratoon grown from oven-treated seed averaged 19.6 and 17.3 per cent, respectively. The rate of increase was 4.3 to 1 in the plant cane and 3.8 to 1 in the first ratoon. The more rapid rate of increase of the disease in the plant cane may possibly be explained on the basis that both the bottom and top knives of the harvester served to spread the disease in the stalks used for seed, while only the bottom knife served to spread the virus to ratoon pieces.

TABLE 5.—Summary of Increase of Ratoon Stunting Disease in Plant Cane and First Ratoon of Hot-Air Treated Cane

		Treated Plant Cane			Plant Cane Grown From[1]			1st Ratoon Grown From[2]		
Years Treated	No. Lots	No. Stalks Exam.	No. Stalks Dis.	% Dis.	No. Stalks Exam.	No. Stalks Dis.	% Dis.	No. Stalks Exam.	No. Stalks Dis.	% Dis.
C.P. 44-101										
1955-56	21	723	39	5.4	467	99	21.2	413	65	15.7
C.P. 36-105										
1955-56	12	265	6	2.3	208	26	12.5	230	33	14.3
C.P. 43-47										
1955-56	7	236	10	4.2	217	50	23.0	119	34	28.6
Totals	40	1224	55	4.5	892	175	19.6	762	132	17.3
Rate of Increase							4.3			3.8

[1] The first progeny of direct treated material. The material examined actually was the second progeny of treated seed.
[2] Direct oven-treated seed. Seed was cut once as plant cane.

In studies made on the main station at Baton Rouge, the presence of the disease was determined by examination of mature stalks in the fall of the year. The amount of disease found was slightly lower when the reddish-orange discoloration of vascular bundles of mature stalks rather than the pink discoloration of the growing point was employed as the diagnostic symptom.

Concurrent with the above study were investigations to determine the rate of increase of the disease in treated cane when mechanically harvested and when cut with a sugarcane knife. The rate of spread of the disease by the cane knife was found to be about the same as that of the mechanical harvester.

Recommendations for the Control of Ratoon Stunting Disease in Louisiana by the Hot-Air Treatment of Seed Cane

Operation of Electric Hot-Air Oven

The following procedures are to be used in the treating operation with the electric hot-air oven in order to obtain satisfactory disease control. These precautions and suggestions were compiled during a three-year period of "on the farm" operational checks made by scientists and producers.

1. Use an in-going air temperature (at thermometer level in the two rear ducts) of 58° C. or 59° C., depending on the variety. C.P. 44-101 is treated at 59° C., all others at 58° C.
2. Total time for the treatment is 8 hours. Controls (thermoswitches) will begin to cycle after 3 to 3½ hours of operation. Continue treating for additional 5 or 4½ hours at recommended temperature.
3. Do not overload the box. *This is Important.* Leave a space at least two inches between uppermost layer of cane and the pipe immediately above. This space allows air circulation between the layers of cane and is absolutely necessary for good disease control.
4. Be certain that cane does not fall through supports or racks, which will cause a blocking of air circulation. This is particularly important at the beginning of the planting season because of the shortness of the cane.
5. Cane to be heat-treated should be thoroughly clean (free of leaves and loose trash). Green leaf sheaths adhering to top of stalks do not have to be removed if right around stalk.
6. Cane to be heat treated should be hand cut.
7. The time between cutting and treating should not exceed 24 hours.

Cleaning cane for heat treating in hot-air oven.

8. Cane should be stacked on racks in such a way that cane will be at least one foot from rear of box. This is necessary to permit proper air passage.
9. Open treating chamber door immediately after treatment is completed to permit cane to cool. Failure to do so will result in poor germination.
10. Clean box after each variety is treated and keep area around box clean. This will prevent an untreated stalk from being mixed with treated material.
11. Check heating cones and mechanical operation before each treatment. Be sure that temperature is maintained as recommended, that is, a temperature of 58° C. or 59° C. at all times after desired temperature is reached.
12. In Louisiana, treating of cane may be started, if cane is long enough, after August 1 and continued through a period not later than October 1.
13. Check seed source for symptoms of mosaic. This is particularly important in N.Co. 310, C.P. 44-101, C.P. 52-68, and Co. 290. Canes showing mosaic should not be treated for planting.

14. Erect varieties such as C.P. 44-101 and C.P. 43-47 should be stacked loosely. This will aid in better circulation throughout the entire stack, resulting in better disease control.
15. Make sure boxes are completely air tight at all times. This is important because in boxes not completely air tight, the temperature will not level off at the desired time.

Planting, Cultivating, and Harvesting Treated Cane

The following recommendations on planting, cultivating, and harvesting heat-treated cane were compiled by scientists of the Louisiana Agricultural Experiment Station and the United States Sugarcane Field Station at about the same time plans for the oven were made available to the industry.

1. Wagons to be used to haul cane from the heating unit to the field must be clean of all cane or pieces of cane before treated cane is loaded. If possible, it is suggested that different wagons be used to haul field-run cane and treated cane.
2. Check fields of seed cane to be treated to make sure varietal mixtures do not exist, and plant in land free of volunteer cane.
3. If possible, plant treated seed in land that has been out of cane for at least two years.
4. Plant at regular field planting rate (two stalks and a slight lap).
5. Plant cane immediately after treating if possible.
6. Do not cut or "whack" cane in the furrow. After treatment, all the eyes on the stalk will germinate at the same time.
7. If possible, water cane in furrow before covering to insure good stand. If moisture is plentiful, watering is not needed.
8. Cover with only 3 inches of soil at time of planting, but plan to re-cover after cane comes up.
9. After first covering, roll or cultipack tops of rows.
10. Cover crops should not be planted over treated cane.
11. It is recommended that treated cane not be shaved; however, if shaving is done:
    (a) Use the shaver in the treated cane first, then shave field-run cane, or
    (b) Treat the blade with steam or by flaming, or
    (c) Run the shaver through one row of land that does not have cane planted, or stubble pieces, or volunteer cane on it.
12. Cultivation implements should be scoured by running the implement through one row that does not have cane planted, stubble pieces, or volunteer cane on it.
13. Use chemicals as method of weed and grass control rather than hoeing, to reduce possible recontamination.

14. Either cut the treated seed first or allow the harvester to lay-up one week after cutting field-run seed cane before going into treated seed cane.

15. If cane knives are used to cut treated seed cane, use new knives or disinfect the knives in boiling water, by flaming, or by using a 2 per cent Lysol solution. When using a Lysol solution, scrub or swab the knives, harvester cutting blades, and chains thoroughly until all accumulated coating of dirt and juice is completely removed.

16. Once the treating program is underway it is suggested that the first stubble of treated cane be *re-treated*. This is to be done in order to eliminate any disease that may have escaped during the first treatment.

If the above precautions are followed during planting, cultivating, and harvesting of treated cane, recontamination will be held to a minimum. Unless recontamination occurs by introducing the disease from untreated cane to the treated cane, the treatment should result in disease-free cane for a number of years.

Hot Water as a Control for Ratoon Stunting Disease

In tropical countries hot-water, instead of hot-air, is used for treating seed cane to control the ratoon stunting disease for the following reasons:

1. Sugarcane used for seed purposes is older and consequently more mature than cane used for seed in Louisiana, and is not injured severely by the hot-water treatment.

2. Planting and milling are done at the same time, making hot-water available at mills for treating seed cane. This is not the case in Louisiana.

3. The planted cane germinates and grows immediately in the tropics, precluding poor stands from rotting of heat-treated seed cane.

For those in tropical areas who may be interested in the hot-water treatment of seed cane the following reference is given:

Antoine, Robert. 1955. Observations on sugarcane diseases in Australia and Fiji. Mauritius Sugar Industry Research Institute. Bulletin No. 5.

ADDENDA

The oven built and being used in Louisiana has the following specifications:

Size: 6 x 6 x 8 feet.

Material used: 4 x 4 x 8 feet sheets of plywood of ¼ and ½ inch thickness.

Capacity: 2,000 to 2,200 pounds of cane.

Source of heat: Electricity; space heater cones operated on 110 volts, 660 and 1,000 watts.

Air circulation: Blower w/¾ HP motor operated on 220/208/1/50 or 60 current.

Electrical supply: Autotransformer between power source and 100 amperes disconnect switch.

Recirculation: Completely closed system.

Temperature used: 58° C. or 59° C., depending on variety (air entering rear of oven).

Treatment period: Total of 8 hours; requires 3 to 3½ hours before oven reaches desired temperature. Time clock is pre-set for cutoff after 8 hours treatment.

Loading: Mobile type rack.

Oven may be purchased from Doherty Manufacturing Company, Baton Rouge, Louisiana, U.S.A., or Mr. Logan Perkins, Export Machinery, International Trade Mart, New Orleans, Louisiana, U.S.A.

LITERATURE CITED

1. Abbott, E. V. 1938. Red rot of sugarcane. U.S.D.A. Tech. Bul. 64
2. Abbott, E. V. 1953. The occurrence of a hitherto unrecognize growth-retarding disease of sugarcane in Louisiana. Sugar. Bu 31: 116-120.
3. Arceneaux, George, I. E. Stokes, and C. C. Krumbhaar. 193 Variety tests of sugarcane in Louisiana during the crop yea 1933-34 and summary of annual results of 1926-34. U.S.D.A. Ci 395. 31 pps.
4. Arceneaux, George, and L. P. Hebert. 1943. A statistical analysi of varietal yields of sugarcane obtained over a period of year J. Am. Soc. Agron. 35: 148-160.
5. Arceneaux, George, and R. T. Gibbens, Jr. 1939. Tests of suga cane in Louisiana during the crop year 1936-37 and summar of annual results 1935-37. U.S.D.A. Cir. 531. 27 pps.
6. Arceneaux, George, and L. P. Hebert. 1948. Yield trends i tests of sugarcane varieties and in annual production of can and sugar in Louisiana. Sugar Bul. 26 (18) : 289-298.
7. Denley, C. L. 1938. Yield trends in Louisiana as affected by varieties. Proc. 9th. Cong. Int. Soc. Sugarcane Tech. 714-718.
8. Edgerton, C. W. 1938. Stubble deterioration. Proc. 6th. Cong. In Soc. Sugarcane Tech. 334-342.
9. Edgerton, C. W. Sugarcane and its diseases. Louisiana State University Press. 1955, 1958.
10. Hughes, C. G. 1955. Some recent developments in the study o ratoon stunting disease. Cane Growers' Quart. Bul. (Queensland 19: 27-28.
11. Rands, R. D., and E. Dopp. 1934. Variability of Pythium arrhenomanes in relation to root rot of sugarcane and corn. Jour Agr. Res. 49: 189-221.
12. Rands, R. D., and E. V. Abbott. 1938. Sugarcane diseases in th United States. Proc. 6th Cong. Int. Soc. Sugarcane Tech. 202-212
13. Schexnayder, C. A. 1956. The ratoon stunting disease of sugarcan in Louisiana with notes on its control. Proc. 9th. Cong. Int. Soc Sugarcane Tech. 1058-1065.
14. Schexnayder, C. A., and E. V. Abbott. 1957. Study during 1956 o the effects of stunting disease on yields of cane and sugar i Louisiana. Sugar. Bul. 35 (22) : 334-339.
15. Steib, R. J., and S. J. P. Chilton. 1950. Recent studies conducte on the ratoon stunting disease of sugarcane in Louisiana. Suga Bul. 34 (16) : 238-243.

16. Steib, R. J., and S. J. P. Chilton. 1950. The Phytophthora rot of sugarcane seed pieces in Louisiana. Proc. 7th. Cong. Int. Soc. Sugarcane Tech. 524-528.

17. Steib, R. J., I. L. Forbes, and S. J. P. Chilton. 1956. Occurrence of the ratoon stunting disease in Louisiana and its control by the use of hot-air treatments. Sugar Bul. 34 (20) : 302-303, 306.

18. Steib, R. J., and I. L. Forbes. 1957. Johnson grass and corn as carriers of the virus of ratoon stunting disease of sugarcane. Sugar Bul. 35: 375-379.

19. Steindl, D. R. L. 1950. Ratoon stunting disease. Proc. 7th. Cong. Int. Soc. Sugarcane Tech. 457-465.

20. Steindl, D. R. L. 1957. Alternative hosts of ratoon stunting disease. Cane Growers' Quart. Bul. (Queensland) 20: 101.

21. Summers, E. M. 1934. Types of mosaic on sugarcane in Louisiana. Phytopath. 24: 1040-1042.

etin No. 533 May 1960

Environmental Factors and School Attendance

a Study in Rural Louisiana

ALVIN L. BERTRAND and MARION B. SMITH

Louisiana State University
and
ricultural and Mechanical College

Agricultural Experiment Station
Charles W. Upp
Director

In Cooperation With Agricultural Marketing Service
U.S. Department of Agriculture

FOREWORD

There has been great concern in recent years over the need for improving our levels of living and technology. These aims can be reachec only if we make the best use of our available manpower. The study reported here takes cognizance of the fact that rural youth generally dc not reach their educational potentials, primarily because of poor schoo attendance records. The purpose was to obtain information which coulc be used by various public and private agencies to improve school attendance and attainment levels and educational facilities in rural areas.

This report is based upon research conducted cooperatively by Louisiana State University and the U.S. Department of Agriculture. Undertakings of this nature are in keeping with the goals of the Rural Development Program (under the sponsorship of six Federal departments) to improve rural levels of living.

Louisiana provided a challenging setting for this study inasmuch as its rural population ranks among the lowest in the nation in educational attainment. The findings and conclusions reported are deserving of the close attention of all persons concerned with the future development of the nation's manpower.

Margaret Jarman Hagood

Margaret Jarman Hagood
Chief, Farm Population and
Rural Life Branch, A.M.S.
U.S. Department of Agriculture

Roland J. Pellegrin

Roland J. Pellegrin, Head
Departments of Sociology and
Rural Sociology
Louisiana State University

TABLE OF CONTENTS

Page

Introduction 5
  Major Objectives of the Study 5
  Method and Procedure of Study 6
  Description of the Sample Parishes 7
  The Enrollment and Teachers of Sample Schools 9
Analytical Approach 10
  Note on Tabular Presentation 12
The Setting: Why Rural Youths Drop Out of School 13
Home Environment Related to School Attendance 15
  Place of Residence Related to School Attendance 15
  Occupation of Father Related to School Attendance 17
  Education of Parents Related to School Attendance 18
  Family Mobility Related to School Attendance 19
  Parental Attendance at School Activities Related to School Attendance 20
  Socio-economic Status of Parents Related to School Attendance 20
  Parents' Attitudes Toward a High School Education Related to School Attendance 22
  Parents' Evaluations of Schools Related to School Attendance 23
  Cost of Schooling Related to School Attendance 26
School Environment Related to School Attendance 27
  Distance from School Related to School Attendance 27
  Employment of Youths Related to School Attendance 29
  Academic Performance Related to School Attendance 30
  Participation in School Organizations Related to School Attendance 31
  Youths' Attitude Toward a High School Education Related to School Attendance 32
  Interpersonal Factors and School Attendance 33
  Youths' Appraisal of Teachers Related to School Attendance 34
  Occupational Aspirations of Youths Related to School Attendance 35
Field Notes and Observations 37
  Observations Relating to Home and Family Life 37
  Observations Relating to School Life 38
Summary and Conclusions 40
  Summary 40
  Conclusions 42

TABLE OF CONTENTS (continued)

Page

LIST OF TABLES

1. Drop-Outs' Reasons for Quitting School, by Sex 14
2. School Attendance Related to Place of Residence 17
3. School Attendance Related to Father's Occupation 18
4. School Attendance Related to Education of Parents 19
5. School Attendance Related to Family Mobility 20
6. School Attendance Related to Parents' Attendance at School Activities 21
7. School Attendance Related to Socio-economic Status of Family 22
8. School Attendance Related to Parents' Attitudes Toward a High School Education 23
9. School Attendance Related to Parents' Evaluations of Schools . . 24
10. School Attendance Related to Cost of Schooling 26
11. School Attendance Related to Distance of Home from School and Type of Transportation to School 29
12. School Attendance Related to Work Experience of Youths 30
13. School Attendance Related to Academic Performance 30
14. School Attendance Related to Youths' Participation in School Organizations 31
15. School Attendance Related to Attitude Toward a High School Education 33
16. School Attendance Related to Selected Aspects of Adjustment in School 34
17. Youths' Appraisal of Teachers Related to School Attendance . . 35
18. School Attendance Related to Occupational Aspirations of Youths, by Sex 36

LIST OF ILLUSTRATIONS

1. Location of Sample Parishes and Schools 8
2. Relation of Selected Aspects of Home Environment to School Attendance 16
3. Relation of Selected Aspects of School Environment to School Attendance 28

Environmental Factors And School Attendance

A Study in Rural Louisiana[*]

Alvin L. Bertrand and Marion B. Smith

INTRODUCTION

Many studies have shown that rural youths have poorer school attendance records, lower educational attainment levels, fewer vocational skills, and lower occupational aspirations than urban youths.[1] These differentials have at least two major implications for the nation. First, they represent a serious talent loss at a time when there is critical need for trained manpower. Second, inequalities in education represent a great handicap to the many rural youths forced to compete with urban youths for employment. The problems which the above situations create are a challenge in the sense that they are not in keeping with our national credo which stresses both equality of opportunity and progress.

Concern over the above and related situations has led the Congress to pass various legislative measures designed to equalize educational opportunities throughout rural areas and between rural and urban communities. This study is one of several being done cooperatively by certain Department of Agriculture agencies and various Land Grant colleges and universities under the Rural Development Program.

It is an attempt to identify and explain the factors which account for differential school attainment in rural areas.

Major Objectives of the Study

The over-all aim of the study, as mentioned, was to determine and describe the factors accounting for differential school attainment in rural areas. Specific objectives were as follows:

1. To determine the factors affecting the school attendance and attainment of rural youth.

2. To determine the life aspirations of rural youths, and evaluate

---

[*] This study is a cooperative project between the Department of Rural Sociology, Louisiana Agricultural Experiment Station, and the Farm Population and Rural Life Branch, Agricultural Marketing Service, U.S. Department of Agriculture.

[1] See for example: Marion B. Smith, "Educational Progress in Louisiana From 1940 to 1949: Comparison of the School Advancement of Urban, Rural-Farm and Rural-Nonfarm Children," *Louisiana Schools,* Volume XXXIII, No. 9 (1956), 8-12.

the extent to which their educational facilities are serving these aspirations.

3. To develop information that could be used by various public and private agencies to improve school attendance and attainment levels, and educational facilities in rural areas.

Method and Procedure of Study

The objective and setting of this study were such as to present special methodological problems. Since the study related to the Rural Development Program, it had to be done in relatively low income areas. In addition, it was evident that sampling procedures and questionnaires had to be worked out for several different population groups. Decisions regarding the above considerations were made after consultation with representatives of the Louisiana State Department of Education, the Vocational Education Department of Louisiana State University, and the Louisiana Agricultural Extension Service.

It was decided to conduct the study in two parishes (counties), Avoyelles in south central Louisiana and Franklin in north central Louisiana. Both of these parishes are "pilot counties" in the Rural Development Program. Other characteristics which made them ideal for this study will be apparent in the description of the study area which follows.

Once the study areas had been selected, a decision had to be made regarding the specific populations to be interviewed. It was obvious that certain classes of rural youths in school and rural youths who had dropped out of school should be questioned. A decision was made to interview the juniors and seniors in four carefully selected white rural high schools in each of the study parishes and the drop-outs from these schools in the same age group (16-19 years) as the juniors and seniors. Furthermore, it was felt that the parents of both groups of youngsters should be interviewed to determine whether parental and family influence related significantly to the problem under study.

Accordingly, three questionnaires were developed for the personal interview of a sample of persons in each of the population groups named above. These schedules were pre-tested and modified in the light of the findings. It is important to note that a decision was made to interview either the father or mother of youths rather than the mother alone, as had been done in some previous studies. The pre-test indicated that fathers were frequently present during interviews and that their attitudes were essentially the same as the mothers. In addition, the role of the father as decision maker structured the situation in such a way as to make the wife hesitant to answer freely, in instances where both were present.

The interviewing for the study was done in January, February, and

March, 1959. In administering Schedule I, designed for the youths still in school, members of the research team traveled to the schools being studied, and had all members of the junior and senior classes complete the questionnaire in the classroom. The second questionnaire, Schedule II, was designed for youths 16-19 years of age who had dropped out of the sample schools. A substantial number of the drop-outs were still living in their home parishes and were easily located. A smaller proportion had moved away and could not be found. (Resources did not permit an individual follow-up of persons having moved out of the state.) Questionnaires were mailed to every drop-out who could not be contacted but for whom an address was available. The response to mailed questionnaires was negligible, however.

The third questionnaire (Schedule III) was designed (with certain alternative questions) for the interview of parents of both groups of youths. A random sample of one-third of the youths still in school was drawn and one parent of each youth in this sample was interviewed. For the drop-outs, interviews were conducted with all corresponding parents (father or mother) who could be found.

In Avoyelles Parish a total of 190 youths in the eleventh and twelfth grades completed schedules. Of these, 102 were completed by females. A total of 179 schedules were obtained from juniors and seniors in Franklin Parish, 93 of which were from females. Altogether, data were obtained from 174 boys and 195 girls.

The drop-outs interviewed were distributed as follows: In Avoyelles Parish, 17 boys and 22 girls from 16 to 19 years of age were questioned. The Franklin Parish interviewees included 15 boys and 14 girls. Taken together, a total of 68 drop-outs from 16 to 19 years of age were included. It may be noted that approximately three-fifths (58.2 per cent) of all drop-outs from the eight schools were interviewed. The majority of those not interviewed had moved from the state.

Altogether, 125 parents of youths in school and 68 parents of youths having dropped out of school were interviewed.

Description of the Sample Parishes

The location of the two sample parishes is shown in Figure 1. A brief review of selected population and agricultural characteristics of these parishes is included to help the reader visualize the setting for the study.

Avoyelles is located in what is known as French South Louisiana. Many residents of the parish use French in their daily conversations, although they may be bi-lingual. A large percentage of the people of the parish belong to the Roman Catholic Church. (It was estimated by the principals of the four sample schools that 98 per cent of their students were Catholic.) Many of the folkways of the people of the parish are traceable to their French cultural background.

There were 38,031 persons in Avoyelles Parish in 1950, according to Census reports. Over one-fourth (26 per cent) of this number were Negroes. The parish ranked well above the state average in percentage of the population classified as rural-farm (45.6 per cent vs. 21.2 per cent) and rural-nonfarm (32.6 per cent vs 24.0 per cent) in residence. Avoyelles Parish residents fall below the state median in educational attainment. In 1950, the median years of schooling for males 25 years of age and over in the parish was 5.8 years. Females in these ages had a slightly higher median of 6.4 years.[2]

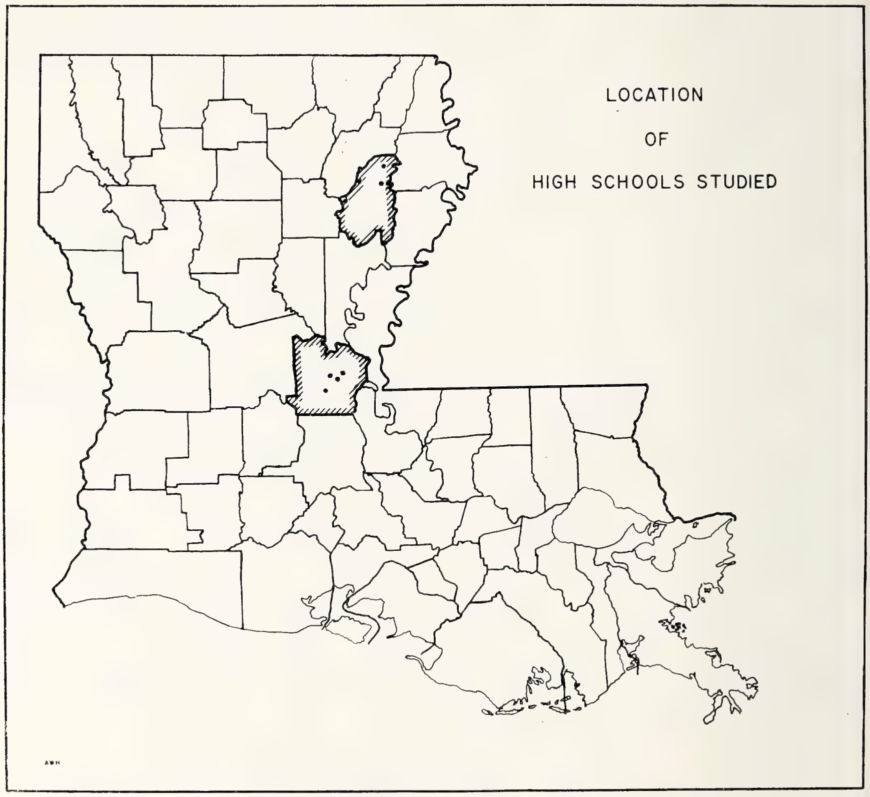


FIGURE 1.—LOCATION OF SAMPLE PARISHES AND SCHOOLS

---

[2] The median school years completed and percentage of functional literacy of adult males in Louisiana in 1949 are shown, by parishes, in: Marion B. Smith, "Educational Progress in Louisiana from 1949 to 1950," *Louisiana Schools,* Volume XXX, No. 7, (1953), 6-7.

There were 4,467 farms in Avoyelles Parish in 1954, 30 per cent of which were tenant operated. The average size of farms was 50.1 acres, with only 1 per cent of all farms being 500 acres or more. The chief crops raised in the parish are cotton, corn, and hay, although a considerable acreage of sweet and Irish potatoes is planted each year. Crop enterprises are supplemented by a sizeable beef cattle, dairy, and poultry industry.

In 1954, 93 per cent of the farms in the parish were served with electricity, but only 21 per cent had telephones.

Franklin Parish is located in Non-French North Louisiana. The residents of the parish are chiefly of Anglo-Saxon descent, and the principals of the schools studied estimated that 98 per cent of the students were Protestants.

The 1950 census reports indicate there were 29,376 people in Franklin Parish at that time. Close to two-fifths of the population (37 per cent) were Negroes. It is significant that the parish included a higher percentage of rural-farm residents (75 per cent) than the majority of the parishes of the state. Only 13 per cent of the residents of the parish were classified as urban.

At mid-century the educational attainment of Franklin Parish residents 25 years and over was well below the state average. Among the males, the median years of schooling completed was 5.7 (compared with 7.4 for the state), and among the females it was 6.7 (as compared with 7.9 for the state).

There were 4,171 farms in Franklin Parish in 1954. Almost three-fifths (58 per cent) of this number were operated by tenants. Farms averaged 79 acres in size, and 1.2 per cent of them were 500 acres or over. Cotton and corn are the predominant crops of the parish, although considerable hay and oats are grown. Beef cattle have increased in popularity as a farm enterprise in recent years.

Almost all the farmers of the parish reported electricity on their farms in 1954 (98 per cent). However, only one-fifth of them (20 per cent) said they had telephones.

The Enrollment and Teachers of Sample Schools

The location of the schools studied is shown in Figure 1. Each school was selected after consultation with the parish superintendent of schools. Four schools with 12 grades were selected in each parish. At the beginning of the school year, the individual enrollment of the four schools in Franklin Parish was 164, 210, 429, and 503 for a total of 1,306. The enrollment in the schools in Avoyelles Parish was 321, 326, 347, and 505, respectively, for a total of 1,499. The total high school enrollment was

421 in the four Franklin Parish schools and 492 in the four Avoyelles Parish schools.

The number of high school teachers ranged from 5 to 12 in the eight sample schools. Altogether, the four schools in Franklin Parish had a total of 37 high school teachers. The four schools in Avoyelles Parish had a total of 33 high school teachers. For the most part, the teachers in the sample high schools had a long tenure. Twenty teachers from each parish had at least 10 years teaching experience. Most of the teachers lived in the home community of their school, and the majority were born and reared locally.

In the sample schools, ten of the high school teachers in Avoyelles Parish and six of the high school teachers in Franklin Parish held master's degrees. All of the remainder of the high school teachers in both parishes, except one, held bachelor's degrees.

It may be noted that the schools studied were in an era of enrollment decline related to a decline in the general population. This fact occasioned some insecurity among the administrators and teachers of the schools.

ANALYTICAL APPROACH

The analysis of findings from a study such as the present one must proceed in terms of a theoretical model. Since it is proposed that readers go beyond the mere descriptive treatment of data, it was felt that it would be helpful to briefly outline the conceptual scheme in mind for the analyses of the findings.

By way of introduction, it may be noted that there have been many studies of educational attainment in rural areas. Most of these studies have concentrated on showing the relationship of certain socio-economic characteristics to school achievement.[3] A few researchers have gone so far as to explore the relationship between farm residence and levels of educational and occupational aspiration.[4] Beyond this, a host of descriptive investigations (some done in rural settings) have demonstrated the relation of social class to individual and group attitudes, opinions, judgements, and aspirations.[5] In the light of the findings of previous studies, the present writers assumed that differentials in school attainment in rural areas stemmed from participation in separate "concrete social systems." In this regard, the conceptual scheme of the rural social system presented by Loomis and Beegle is used as a frame of reference.[6] Loomis and Beegle state that "social systems are organizations composed of persons who interact more with members than with non-members when operating to attain the system's objectives."[7] They further say that social systems should be looked upon as functioning entities or wholes which are composed of interrelated parts or elements. Herbert Blumer, in the foreword to Loomis and Beegle's *Rural Sociology*: *Strategy of Change,* writes that the social system is an analytical scheme that "can be applied readily and meaningfully to the structure of rural society."

---

[3] See: Selected Bibliography on Rural Education, Washington, D.C.: Department of Rural Education, National Education Association, 1954. For one of the later studies, see: E. Grant Youmans, *The Educational Attainment and Future Plans of Kentucky Rural Youths,* Lexington: Kentucky A.E.S. Bulletin No. 664, 1959.

[4] See, for example: Archie O. Haller and William H. Sewell, "Farm Residence and Levels of Educational and Occupational Aspirations," *The American Journal of Sociology,* Vol. LVII (1957) 407-411, and Russell Middleton and Charles M. Grigg, "Rural-Urban Differences in Aspirations," *Rural Sociology,* Vol. 24, (1959), 347-354.

[5] For recent examples, see: Alan B. Wilson, "Residential Segregation of Social Classes and Aspirations of High School Boys," *American Sociological Review,* Vol. 24, (1959), 836-845, and E. Grant Youmans, "Factors in Educational Attainment," *Rural Sociology,* Vol. 24, (1959), 21-28.

Social systems are characterized by two common elements, social structure and value orientation. The social structure of social systems may be explained as follows. In every society an individual learns quite early in life that certain members of the society act in special ways, according to their status-role positions. Each individual's behavior is guided by a set of rules or "norms" of behavior which relate to specific social action systems in society. Thus, if the individual has high status in a given system, he has more authority or power (the privilege of influencing the action of others). Behavior, according to normative patterns and in conformity with status-role requirements, is assured because of certain sanctions at the disposal of each social system. Sanctions are simply mechanisms for giving or inflicting "punishment" or, contrarywise, for presenting rewards.

The second component of social systems is value orientation. This includes the non-purposive behavior which persists in interpersonal relations. Illustrations of value orientation are seen in the intangible factors which bind men together, such as loyalty, affection, and kinship. In the words of Loomis and Beegle, "for purposes of empirical procedure, we consider value orientation as including the *ends* or *objectives* and *norms.*" Value orientation not only accounts for the "rules of the game" but for the things, ideas, or goals considered worthwhile.[8]

Loomis and Beegle utilize Toennies' concepts of familistic *Gemeinschaft* and contractual *Gesellschaft* to point up the difference in the value orientation of social systems. They interpret the former as including all human relationships based on emotion or inclination and in which the relationship is an end in itself. *Gesellschaft* systems encompass all associations stemming from rational and calculated wishes to attain given objectives.[9]

---

[6] See: Charles P. Loomis and J. Allan Beegle, *Rural Social Systems,* New York: Prentice-Hall, Inc., 1950, and Charles P. Loomis and J. Allan Beegle, *Rural Sociology*: *The Strategy of Change,* New York: Prentice-Hall, Inc., 1957.

[7] *Rural Social Systems,* p. 33.

[8] *Ibid.*

It was conceived for this study that the school drop-out problem in rural areas could be understood in terms of the two major social systems serving to condition and motivate individual youths—the family and the school. It was hypothesized that one type of family system would tend to emphasize educational goals and objectives, and in fact, encourage children to continue in school by indoctrinating them with educational values and aspirations. Conversely, another family, by virtue of a different value orientation would serve to effectively wean youth from schooling by playing down the value of education.

The schools were conceived as educational social systems which generally would serve to reinforce the positive educational values held by students. However, it was hypothesized that a school system would repel students to the extent that the latter were not accepted as bona fide members of the system.[10]

Note on Tabular Presentation

The reader will note that the data for this study were generally not broken down by sex and sample area. The reasons for this are given below.

Many studies have made a point of excluding girls in studies of high school drop-outs. The rationale for such a decision is usually that the majority of girls leave school to get married, and therefore little purpose is served in studying them, in terms of understanding the causes and effects of dropping out of school. In this study, it was decided that it was just as important to find out how many girls dropped out of school and why they dropped out of school as for boys. The rationale for this decision was that girls who dropped out, whether or not to get married, would be influenced by home and school environments in the same way as boys. Girls from homes that promoted education as a high value, for example, would not be likely to get married before graduation. Likewise, girls enjoying their school experiences would not be prone to leave them. Beyond these considerations, it was felt that the number of young women migrating from rural areas and entering the labor force was sufficient to justify the inclusion of girls in a study such as the present one.

The second procedure which needs explanation is the lumping of data from the two sample areas together. It was explained in the introduction that the two sample parishes were selected because they were more or less representative of north and south Louisiana, respectively.

---

[9] *Rural Sociology: The Strategy of Change,* p. 12

[10] See: *Ibid.,* Chapters 3 and 8 for a discussion of the family and school as ongoing social systems.

It was also pointed out that the culture bases of the people in the two sample areas were quite different. However, it was thought best to group the data from the two sample areas because the sample for drop-outs was so small as to make intra-parish comparisons hazardous from a statistical reliability standpoint. A later study is planned to determine the significance of cultural differences to school attainment.

With respect to the tabular presentation, the reader will note that the N's for the different classes of interviewees vary slightly from one table to the next. This is because the number of "no responses" varied somewhat from one question to the next.

The chi square measure of probability was used exclusively in testing the homogeneity of the data presented. Tables where the difference between variables is significant at the .01 level are indicated. Differences at the .05 level were generally considered not significant because of the smallness of the sample.

THE SETTING: WHY RURAL YOUTHS DROP OUT OF SCHOOL

A first concern of the present study was the determination of the reasons why rural youths in the sample population dropped out of school. This information was considered basic to the study for several reasons. First, it would be possible to compare the findings in the study area with the findings of other studies. Second, it was hoped that clues to the underlying causes for the drop-out problem might be obtained in this way. In addition there would be an opportunity to determine the magnitude and seriousness of the problem.

Questions relating to the reasons for dropping out of school were put to the drop-outs themselves, to their parents, and to the principals of their schools. The responses of each group of interviewees is described and compared below, and where applicable the findings of certain previous investigations are reported.

The various reasons given by youths, when asked why they had dropped out of school, are shown in Table 1. It can be seen that by far the largest number (28) dropped out of school because of what could be termed "lack of interest." Over half of the 35 girls interviewed left school because of marriage, and this accounts for marriage ranking second as a reason for leaving school. Ten youths indicated they left school because they were needed at home and six others left for what they described loosely as "financial" reasons. The remaining three said they had to leave school because of health reasons.

Parents of drop-outs agree with their children regarding the reasons why the youths left school. Practically the same percentage of parents and of drop-outs listed each of the separate reasons cited above.

The principals of the schools studied also cited lack of interest and marriage as the major reasons for students' dropping out of school. Although principals were not quizzed about individual drop-outs from their schools, they were asked to give their over-all impressions of the important reasons for this problem. Typical comments were as follows: "They don't get encouragement at home," or "They do not receive cooperation from their parents."

TABLE 1.—Drop-Outs' Reasons for Quitting School, by Sex

Reasons	Males	Females	Totals
	Number	*Number*	*Number*
Needed at home	4	6	10
Financial reasons	5	0	5
Marriage	1	19	20
Lack of interest	20	8	28
Health	1	2	3
Total	31	35	66

The findings of this study are almost identical to the findings of other studies in and out of the state. For illustration, a study done of the drop-outs from the Calvin, Louisiana, High School in 1956 revealed that the three principal reasons for dropping out of school were: (1) lack of interest, (2) to work, and (3) to marry.[11] The conclusion of a recent study done in Whitman County, Washington, was that rural boys dropped out of school most frequently because they were not interested in school work. Girls usually dropped out because they wanted to get married.[12]

From the above it is clear that rural youths from low income areas who drop out of school generally do so because of lack of interest or motivation. As a matter of fact, when asked if they regretted quitting school, three-fifths of the boys (61 per cent) and one-half of the girls (47 per cent) said, "no." When asked if anything would have kept them in school, over two-thirds (68 per cent) of the boys and almost three-fourths (73 per cent) of the girls said, "no." The basic problem of drop-outs is therefore the apathy of youth. The remainder of this report is devoted to an investigation of the cause for this "negative" approach to schooling.

---

[11] Maxey, James W., "Why Students Drop Out of Calvin, Louisiana High School Before Graduation," unpublished master's thesis, Louisiana State University, Baton Rouge, Louisiana, 1956.

[12] Carol Larson Stone, *High School Drop-Outs in a Rural County, Their Problems and Adjustment,* Pullman: Washington AES Bulletin No. 565, 1956, p. 17.

HOME ENVIRONMENT RELATED TO SCHOOL ATTENDANCE

Many studies have shown that members of different socio-economic strata, as individuals and groups, have differing value orientation.[13] In general, studies of this nature have indicated that members of the working classes or of families representing the lower rungs of the socio-economic scale have tended to devalue education. In other words, they do not feel that educational attainment makes a significant difference in one's life. In turn, parents from these socio-economic levels do not, as a rule, indoctrinate their children with high educational aspirations.

The latter process has been called "social inheritance," and it explains much about the way people behave. The thesis of this study, as brought out before, is that differentials in school attendance can partially be explained on this basis. It is hypothesized that the attitudes and values toward education which a youngster learns at home go a long way toward explaining his success in school.

The discussion that follows is designed to show some aspects of the home environment of youths still in school and of those who have dropped out of school. If the hypothesis indicated above is correct, the home environment of drop-outs should have certain definite and recognizable characteristics and they and their parents should hold relatively low educational values.

Place of Residence Related to School Attendance

Each youth questioned was asked to state whether he lived on a farm; in the open country but not on a farm; or in a population center of 2,500 persons or less. (No population centers of over 2,500 persons were involved in the study.) The purpose in mind was to determine whether place of residence was significantly related to school attendance.

Altogether, 63 per cent of the youths still in school and 73 per cent of the youths who had dropped out of school were from farm homes. Some 13 per cent of the former group lived in the open country but not on farms and 24 per cent were from homes in towns and villages. Only 17 per cent of the drop-outs said they lived in the open country but not on farms. One out of every 10 drop-outs lived in a population center of less than 2,500 people. (See Table 2.)

The percentage differences between the two classes of youths with residence in the categories shown above are not significant. This finding indicates that in rural areas residence on a farm or off a farm is not an important factor in school attendance. It should not be concluded that residence will not be important in rural-urban comparisons, however.

---

[13] Wilson, *op. cit.*

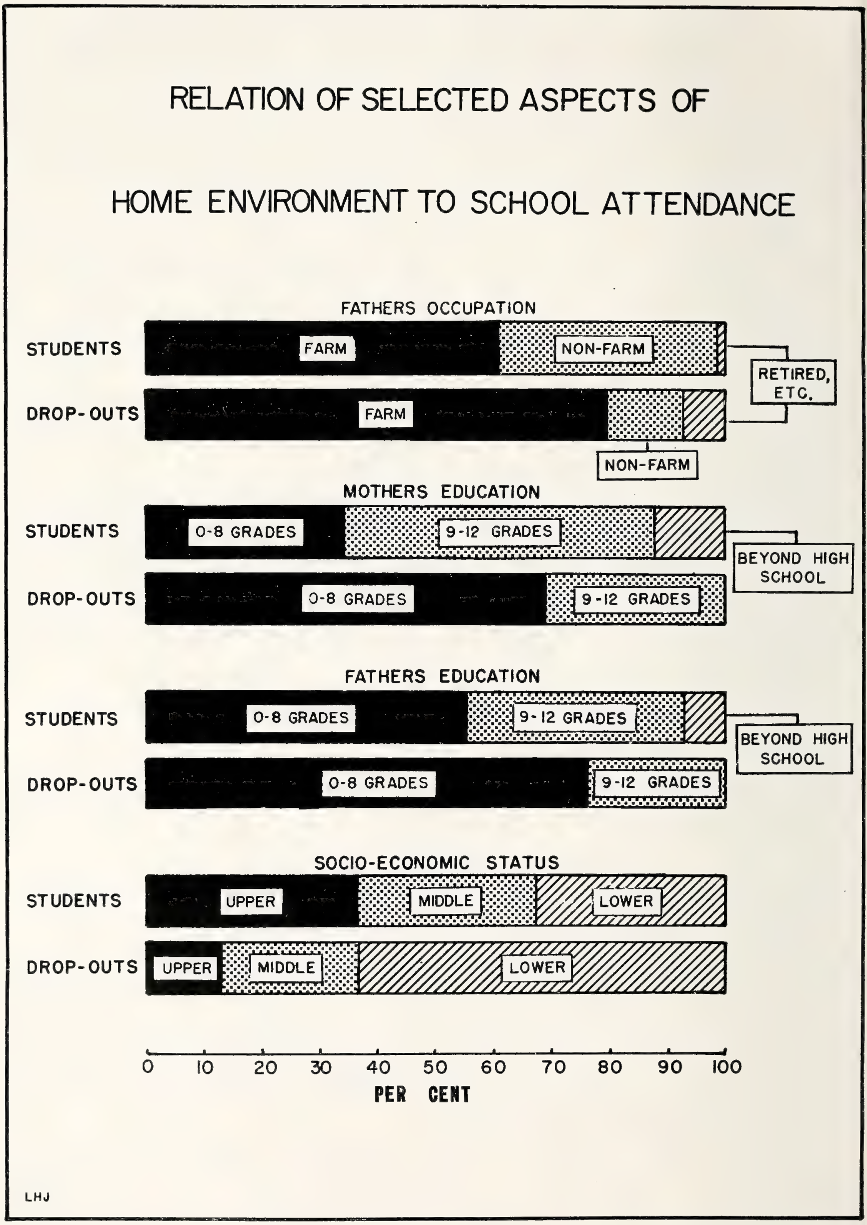


FIGURE 2.—RELATION OF SELECTED ASPECTS OF HOME ENVIRONMENT TO SCHOOL ATTENDANCE

TABLE 2.—School Attendance Related to Place of Residence

Residence	Youths in School		Drop-outs	
	Number	*Per Cent*	*Number*	*Per Cent*
Rural non-farm				
1. Population centers less than 2,500	89	24	7	10
2. Open country	49	13	11	17
Rural farm	230	63	48	73
TOTALS	368	100	66	100

Occupation of Father Related to School Attendance

Studies have shown that a high level of educational aspiration and achievement is more typical of the so-called white collar classes than of the working classes.[14] For this reason, it was deemed worthwhile to investigate the occupation of the fathers of youths in the study groups.

Of the youths in school, three-fifths came from homes where the father was a farmer. In contrast, four-fifths of the drop-outs' fathers were farmers. The fathers of the remainder of each group were doing non-farm work. Five fathers of youths in school and four fathers of drop-outs were either deceased or retired.

The above findings indicate a significant relationship between occupation and school attendance, as may be seen in Table 3. Youths from homes where farming or farm work is the father's occupation definitely drop out of school faster than youths from homes where the father is not a farmer.

At first glance, this finding seems to contradict the finding that residence is not significantly related to school attendance. However, it must be remembered that a family can live in a small town or in the open country not on a farm and the father still be employed as a farm laborer or even own and operate a farm.

Youths whose fathers were farmers were asked whether their fathers were farm operators or farm laborers. It was found that children of farm laborers are significantly more prone to drop out of school than the children of farm operators. (See Table 3.)

Youths whose fathers had non-farm jobs were asked if their fathers were in business or professional work or were doing wage work. Interestingly, 30 per cent of the fathers of non-farm, in-school youths were in business or professional work of one kind or another, but no father of a drop-out, not farming, did anything but wage work.

---

[14] S. M. Lipset and R. Bendix, *Social Mobility in Industrial Society,* Berkeley: University of California Press, 1959, Chap. 9.

TABLE 3.—School Attendance Related to Father's Occupation

Occupation	Youths in School		Drop-outs	
	Number	*Per Cent*	*Number*	*Per Cent*
General class*				
Farm	199	61	50	79
Non-farm	120	37	9	14
Other	5	2	4	7
TOTAL	324	100	63	100
Farm*				
Operator, full-time	117	59	18	36
Laborer	46	23	26	52
Operator, part-time	36	18	6	12
TOTAL	199	100	50	100
Non-farm*				
Business and professional	36	30	0	0
Wage worker	84	70	9	100
TOTAL	120	100	9	100

*Differences between youths in school and drop-outs are statistically significant at the .01 level, as measured by the chi square test.

The above findings support the hypothesis of the study. It demonstrates that youths whose fathers are in the lower socio-economic levels are more likely to drop out of school. In this regard, many investigators have demonstrated that farm laborers as well as non-farm workers have relatively low levels of living and of education and participate minimally in community life and institutions.

Education of Parents Related to School Attendance

Children of parents with a high degree of formal education tend to have high educational achievement. For this reason, it was deemed important to determine educational differentials between parents of youths still in school and of youths having dropped out of school.

As may be seen in Table 4, no parent of drop-outs had college experience, but 13 per cent of the mothers and 7 per cent of the fathers of children still in school had attended college. At the opposite extreme, 76 per cent of the fathers and 69 per cent of the mothers of drop-outs had not obtained formal schooling beyond the eighth grade. The comparable percentages for parents of youths still in school were 55 per cent and 34 per cent, respectively.

It is clear to the most casual observer that parents' education is significantly related to school attendance. There is little question as to the importance of the above finding. Obviously, the level of education of parents represents part of the family environmental complex of youths.

The inference can be drawn that parents with education are more likely to see the advantages of schooling and to place a high value on education. These values are, in turn, transmitted to their children. This is not to say that all parents without a great deal of formal schooling do not have an appreciation for higher education. Such an appreciation may be developed through informal means. Nevertheless, the fact stands that the educational attainment of parents relates closely to their children's school attainment.

TABLE 4.—School Attendance Related to Education of Parents

Formal Education of Parents	Youths in School		Drop-outs	
	Number	*Per Cent*	*Number*	*Per Cent*
Educational attainment of mother*				
0-8 grades	118	34	41	69
9-12 grades	184	53	18	31
College experience	46	13	0	0
TOTAL	348	100	59	100
Educational attainment of father*				
0-8 grades	191	55	47	76
9-12 grades	133	38	15	24
College experience	26	7	0	0
TOTAL	350	100	62	100

*Differences between youths in school and drop-outs are statistically significant at the .01 level, as measured by the chi square test.

Family Mobility Related to School Attendance

The mobility, for the past 10 years, of the families of the youths studied was ascertained. Approximately the same percentage of drop-out families (83 per cent) and of non-drop-out families (78 per cent) had not changed residences in this time. In both groups the majority of the families making a move had made only one or two moves. Just 7 per cent of the families with youths in school and 8 per cent of the families with drop-outs had moved at least three times. (See Table 5.) These findings indicate that family mobility has little effect, if any, upon school attendance because of the low mobility of the families studied. This pattern is not unusual in rural areas.

TABLE 5.—School Attendance Related to Family Mobility

Family Moves in Past 10 Years	Youths in School		Drop-outs	
	Number	*Per Cent*	*Number*	*Per Cent*
No moves	281	78	55	83
1-2 moves	53	15	6	9
3 or more moves	25	7	5	8
TOTAL	359	100	66	100

Parental Attendance at School Activities Related to School Attendance

The parents of youths in school attend more school activities than do parents of drop-outs. This pattern is consistent with regards to both athletic events and school plays. These were the two major activities open to the general public in the schools studied. Parent-Teachers Associations were not present in all the schools and therefore could not be studied. (Parents of drop-outs were asked about their participation at the time their children were in school.)

The percentage of parents from the two sample groups who "never attended" school functions dramatically portrays the picture of parental participation in school events. Only about one-fourth of the parents of youths in school stated they never attended school athletic events. In contrast, two-thirds of the parents of drop-outs did not attend such events. Attendance at plays was more pronounced, but comparisons show that 11 per cent of the in-school group as compared with 34 per cent of the drop-out group never attended functions of this type. (See Table 6.)

The findings regarding parental attendance at school activities indicated that certain families follow through in supporting school functions. Such behavior cannot help but reinforce the educational values of their children. It cannot be overlooked, of course, that parents of children who are making a success out of school would have more opportunity to observe their children in action at a school activity, and thus have more incentive to participate as spectators. Community members who relate themselves to their school, generally support its activities.

Socio-Economic Status of Parents Related to School Attendance

One aim of this study was to determine whether or not socio-economic status of parents was related significantly to the school attendance of their children. By socio-economic status is meant the relative position of families with regard to the possession of certain items and facilities such

TABLE 6.—School Attendance Related to Parents' Attendance at School Activities

Activity	Youths in School		Drop-outs	
	Number	*Per Cent*	*Number*	*Per Cent*
Athletic events:*				
Usually	30	25	11	17
Occasionally	58	48	12	18
Never	32	27	43	65
TOTAL	120	100	66	100
Plays and musical events:*				
Usually	53	47	18	28
Occasionally	48	42	24	38
Never	12	11	22	34
TOTAL	113	100	64	100

*Differences between youths in school and drop-outs are statistically significant at the .01 level, as measured by the chi square test.

as refrigerators, automobiles, running water, electricity, etc.[15] Income is measured indirectly in such scales, and problems related to the determination of family income do not arise. Socio-economic status is considered a reliable measure of the relative standing of the particular family in the community.

The interviewee parents, both of youths in school and of drop-outs, were classified into three socio-economic status groups: upper, middle, and lower. Tabulations were made for each group to show which had the highest percentage of drop-outs. Analysis of these data indicates a significant relationship between socio-economic status and school attendance. Only one-third of the youths in school came from families in the lower socio-economic level. Conversely, almost two-thirds (63 per cent) of the drop-outs were from families in the lower socio-economic level. (See Table 7.)

---

[15] The socio-economic status scale used was an adaptation of the Sewell Scale. (William H. Sewell, "A Short Form of the Farm Family Socio-Economic Status Scale," *Rural Sociology,* 8, (1942), pp. 161-170.)

The items listed below were weighted as shown and summed for each family studied. Those families with scores of 83 or more were classed as upper; those with scores from 77 to 82 as middle; and those 76 or below as lower. Items and weights used were as follows:

Electric lighting facilities: Yes (6), No (3)
Water piped into house: Yes (8), No (4)
Power washer: Yes (6), No (3)
Refrigerator: Yes (6), No. (3)
Radio: Yes (6), No. (3)
Telephone: Yes (6), No. (3)
Automobile: Yes (5), No (2)
Daily newspaper: Yes (6), No. (3)
Wife's education: 0-7 years (2), 8 years (4), 9-11 years (6), 12 years (7), 13 years and up (8)
Husband's education: 0-7 years (3), 8 years (5), 9-11 years (6), 12 years (7), 13 years and up (8)
Wife's church attendance: Regular (8), Occasionally (6), Never (3)
Husband's church attendance: Regular (8), Occasionally (6), Never (3)
Construction of house: brick, stucco, painted (5), unpainted (3)
Television: Yes (6), No (3)

The implications of these findings are serious over and beyond their implications for school attendance. Educational programs are needed which will reach these lower socio-economic groups and change their views regarding the value of education. Past experience has shown that such programs are not always invited or readily accepted by these groups.

TABLE 7.—School Attendance Related to Socio-Economic Status of Family

Socio-Economic Status Rank	Youths in School		Drop-outs	
	Number	*Per Cent*	*Number*	*Per Cent*
Upper*	46	37	9	13
Middle	38	30	16	24
Lower	41	33	43	63
TOTAL	125	100	68	100

*Differences between youths in school and drop-outs are statistically significant at the .01 level as measured by the chi square test.

Parents' Attitudes Toward a High School Education Related to School Attendance

Parents of drop-outs do not value a high school education as highly as do parents of youths still in school. Whereas 92 per cent of the latter expressed the opinion that a person without a high school education would be greatly handicapped, only 60 per cent of the parents of drop-outs felt this strongly about a high school education. The evidence that many parents of drop-outs are not clearly convinced of the worth of high school training is further seen in the fact that almost two out of every five of them responded that they could see only a moderate advantage in children continuing through school. Interviewers reported that some of these parents who expressed a "moderate" answer appeared to be giving lip service to what was known by them to be an "ideal" pattern, rather than expressing their true convictions. Only 6 per cent of the parents of youths in school gave answers that indicated a lukewarm attitude toward a high school education. Just two parents from each sample group flatly denied benefits of any kind from high school experience. (See Table 8.)

TABLE 8.—School Attendance Related to Parents' Attitudes Toward a High School Education

Attitude Statement	Youths in School		Drop-outs	
	Number	*Per Cent*	*Number*	*Per Cent*
The lack of a high school education is a disadvantage*				
Great	116	92	38	60
Moderate	7	6	23	37
None	2	2	2	3
TOTAL	125	100	63	100

*Differences between youths in school and drop-outs are statistically significant at the .01 level as measured by the chi square test.

The reported responses of parents make possible the statement that parental attitudes toward education play an important part in whether a child drops out of school. This discovery has implications for the stated hypothesis of the study. It suggests, again, that programs to keep children in school must begin with an educational program for the parents.

Parents' Evaluations of Schools Related to School Attendance

All parents interviewed were asked a series of questions designed to get some indication of how they evaluated the schools their children attended or had attended. Altogether, five questions relating to the program and operation of the schools were included. The answers to these queries are reported here.

(1) Parents are divided in their opinions as to whether the high schools offered enough vocational training. One-half of the parents of youths still in school said that enough vocational training was offered in their children's high schools. However, as many as 43 per cent in this sample group gave an emphatic "no" in response to this query. The remainder did not feel they had enough information to make a response.

The responses of parents with children who have dropped out of school do not differ significantly from the responses of parents with children still in school. Slightly over one-half (52 per cent) of the parents of drop-outs thought the schools offered enough vocational training and about one-third (32 per cent) felt that local schools did not offer enough training of this kind. The remainder (16 per cent) said they didn't know enough about this question to give an answer. The findings regarding this question seem to have at least one implication for action programs.

TABLE 9.—School Attendance Related to Parents' Evaluations of Schools

Parents' Evaluation	Youths in School		Drop-outs	
	Number	*Per Cent*	*Number*	*Per Cent*
High schools offer enough vocational training?				
Yes	62	50	33	52
No	53	43	20	32
Don't know	9	7	10	16
TOTALS	124	100	63	100
High schools give enough homework to students?				
Too much	8	6	8	13
Right amount	102	82	42	67
Too little	15	12	13	20
TOTALS	125	100	63	100
High schools provide enough recreation?				
Too much	15	12	9	14
About right amount	100	81	46	73
Too little	9	7	6	10
Don't know	0	0	2	3
TOTALS	124	100	63	100
Schools making the best uses of the money provided?				
Yes	79	64	29	47
No	5	4	5	8
Don't know	39	32	28	45
TOTALS	123	100	62	100
Need for improving high schools?				
Great	17	14	12	19
Moderate	42	34	17	27
Little or none	60	50	29	46
Don't know	2	2	5	8
TOTALS	121	100	63	100
People in the community are interested in schools?				
Yes	54	44	35	56
No	56	45	19	30
Don't know	14	11	9	14
TOTALS	124	100	63	100

The large number of parents who express the belief that not enough vocational education is offered suggests a felt need for more instruction of this type.

(2) The majority of the parents feel their children are or were given about the right amount of homework. However, the parents of children still in school are more convinced of this fact. Over four-fifths (82 per cent) of this group of parents expressed the opinion that their children were getting the right amount of homework. Two-thirds (67 per cent) of the parents of drop-outs said that they thought their children were given about the right amount of homework when they were in school. A larger percentage of parents of drop-outs (20) than of the parents of non-drop-outs (12) said that local high schools were giving too little homework. Paradoxically, a larger percentage of the parents of drop-outs (13 as compared with 6) also said that the high schools gave too much homework. However, these differences are not large enough to be statistically significant.

The important finding from the above data is that rural people are generally satisfied with the homework assignments their children receive. The impression given interviewers is that this is an area where parents do not feel competent and they tend to endorse the policies of the school.

(3) Most parents feel that the high schools provide about the right amount of recreation for their children. Again the responses of the parents of children still in school and of parents of drop-outs are not significantly different. Over-four-fifths of the former (81 per cent) and almost three-fourths of the latter (73 per cent) expressed the belief that about the right amount of recreation was being provided by local schools. This seems a case where an automatic endorsement is given a school policy, because of lack of strong feeling, one way or another.

(4) The majority (64 per cent) of parents of youths in school feel that the schools are making best use of the money provided them. However, less than half of the parents of drop-outs (47 per cent) are of this opinion. A large percentage of both groups (32 and 45 per cent, respectively) said they did not have enough knowledge to express an opinion on this question. Although the percentage differences between classes of parents are not large enough to be statistically significant, there is indication that parents of youths in school are more in the know regarding school expenditures. Widespread ignorance of the way school funds are used is not unusual in both urban and rural communities, however.

(5) The parents interviewed were divided in their opinions regarding the need for improving their local schools. Their responses to the query of whether or not schools needed improving brought the following re-

sults. About one-half of the parents of drop-outs voiced the belief that there was at least a moderate need to improve the schools. Those persons who indicated improvements were needed, mentioned such things as the need for better buildings, better facilities, and better trained teachers. Interestingly, almost the same percentage of both groups stated that there was little or no need for improving local schools.

(6) The response of parents to the question of whether people living in rural areas are interested in schools is somewhat surprising. A higher percentage of parents of drop-outs (56) than of the parents of youths still in school (44) felt that the people of their community were interested in schools. This reversal of the expected pattern of responses, although it is not statistically significant, leads to some interesting speculation. It is possible that parents of children in school feel more keenly the apathy of community members toward schools.

Cost of Schooling Related to School Attendance

Despite the fact that all of the schools studied were publicly supported, it was thought important to determine whether the financial condiion of parents affected school attendance. The thought in mind was that the costs of such items as clothes, lunches, etc. might be considered beyond the means of the individual family. Consequently, parents interviewed were asked if they felt that keeping their children in school was or had been a financial burden.

Two-thirds of the parents with children in school and 56 per cent of the parents of drop-outs stated that keeping their children in school had not pressed them financially. Perhaps the more important discovery is that one out of every three parents of youths in school and close to half of the parents of drop-outs did feel schooling was an excessive expense.

TABLE 10.— School Attendance Related to Cost of Schooling

Statement of Parent	Youths in School		Drop-outs	
	Number	*Per Cent*	*Number*	*Per Cent*
Keeping child in school is (was) a financial burden?				
Yes	41	33	28	44
No	83	67	35	56
TOTALS	124	100	63	100

Two conclusions may be drawn from the above responses. The first is that finances are an important factor in school attendance. As a matter of fact, the statements of some of the drop-outs indicate this. One girl stated, for instance, "I would have remained in school, if I had had the money for clothes."

The second conclusion is that some families are willing to make a financial sacrifice to keep their children in school. This is evidenced by the relatively large number of parents with children in school who admitted to a financial strain brought on by the cost of schooling. The inference which may be derived from this pattern is that families with strong positive educational values will be more willing to make the necessary financial outlay, even though it means a pinch on the family budget, to keep their children in school.

SCHOOL ENVIRONMENT RELATED TO SCHOOL ATTENDANCE

It is generally conceded that the family environment might condition the child in such a way that he or she would lose interest in school. However, the school itself, with its goals of education so clearly formulated, would not be expected to discourage the student in his quest for learning. Nevertheless, the findings of certain studies have suggested that the school as an ongoing social system has certain characteristics which serve to turn some youths from an education. Interviewees were asked questions pertinent to this and other *a priori* assumptions relating to the school environment. These questions are described in the discussion which follows.

Distance from School Related to School Attendance

Distance is an important factor in social participation of various types. For example, it has been demonstrated that participation in certain community social institutions increases in direct proportion to the proximity of community members.[16] It is thus logical to expect that distance would be a factor in school attendance.

Each youth interviewed was asked how far he or she lived from school. Almost two-fifths of the youths still in school (37 per cent) lived less than one mile from school. In contrast, only 7 per cent of the drop-outs lived this close to the last school they attended. Two-thirds (65 per cent) of the drop-outs lived from 1 to 5 miles from their school, whereas only 31 per cent of the youths still in school lived this far away. A somewhat larger percentage of youths in school than of drop-outs (32 as compared with 24) lived farther than 5 miles from school. The above differences are large enough to be statistically significant. Why it is that drop-outs tend to concentrate in the middle-distances from school is hard to ex-

---

[16] See: William G. Mather, *The Rural Churches of Allegany County,* Ithaca: Cornell University, A.E.S. Bulletin No. 587, 1934.

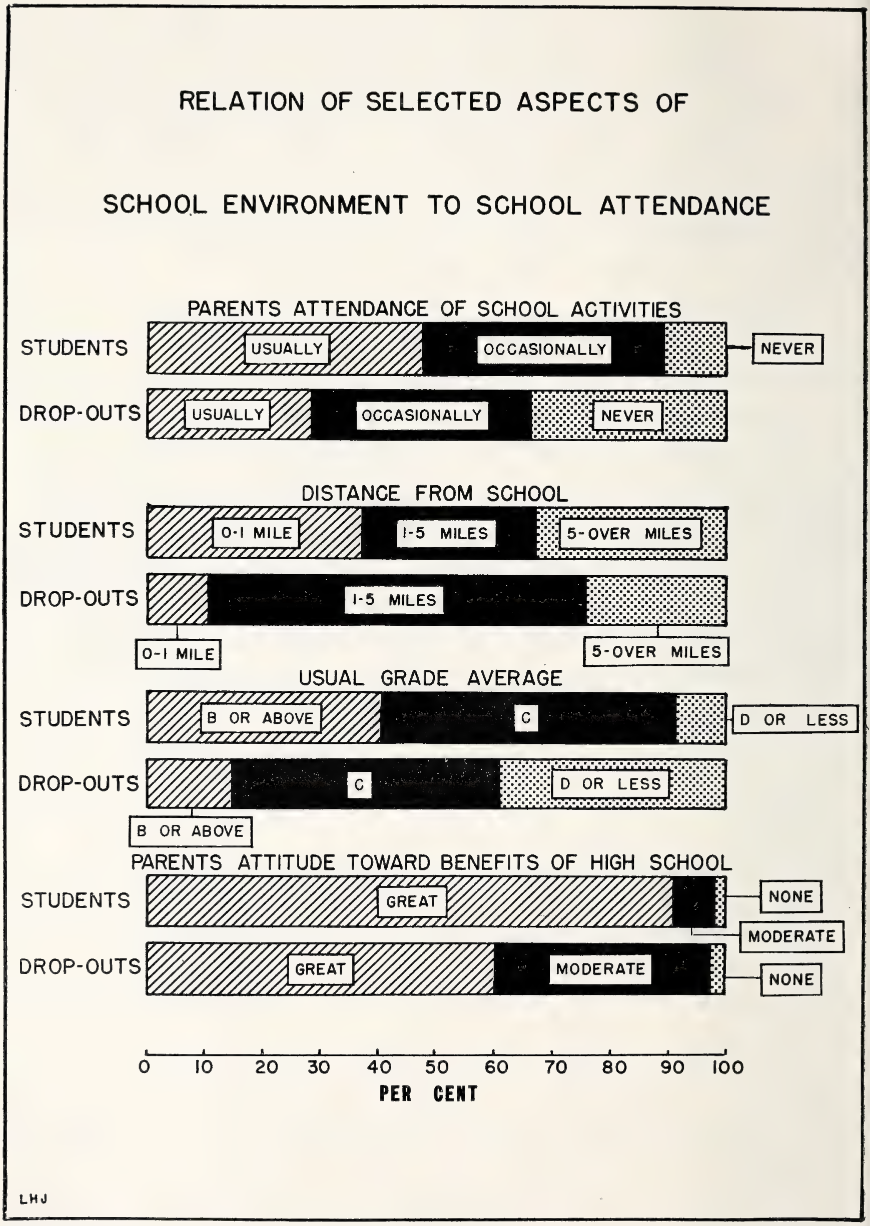


FIGURE 3.—RELATION OF SELECTED ASPECTS OF SCHOOL ENVIRONMENT TO SCHOOL ATTENDANCE

plain. It may be that the youths in school who live farther than five miles from their schools are in higher socio-economic brackets than drop-outs.

If this is true, these parents would likely own or operate choice holdings adjacent to the major highways in greater relative numbers.

TABLE 11.—School Attendance Related to Distance of Home from School and Type of Transportation to School

Distance to School and Transportation Used	Youths in School		Drop-outs	
	Number	*Per Cent*	*Number*	*Per Cent*
Distance from home to school:*				
0-1 mile	135	37	7	11
1-5 miles	115	31	42	65
5 or more miles	118	32	16	24
TOTAL	368	100	65	100
Transportation to school:*				
School bus	254	69	58	88
Private transportation	38	10	1	2
Walk	77	21	7	10
TOTAL	369	100	66	100

*Differences between youths in school and drop-outs are statistically significant at the .01 level as measured by the chi square test.

In this regard, it was reported by interviewers that many of the drop-outs lived off the main highways and had to walk considerable distances to get to the school bus stop.

Employment of Youths Related to School Attendance

Contrary to what might have been expected, a larger percentage of youths in schools than of drop-outs had worked for pay. There appear to be at least two possible explanations for this pattern of behavior. First, certain personality traits, possibly a product of the family environment, carry through in and out of school. In one family system the student is taught to be industrious, energetic, and ambitious and encouraged to make his own way as much as possible. This pattern has been observed in connection with the performance of college students, for instance. Second, youths in school came from higher socio-economic status levels and undoubtedly had more opportunities for gainful employment of a part-time nature. Many relatively well-off families, for example, pay their children for work normally done around the home

TABLE 12.—School Attendance Related to Work Experience of Youths

Gainful Employment Experience	Youths in School		Drop-outs	
	Number	*Per Cent*	*Number*	*Per Cent*
Response*				
Yes	164	46	18	27
No	195	54	48	73
TOTAL	359	100	66	100

*Differences between youths in school and drop-outs are statistically significant at the .01 level as measured by the chi square test.

or business by family members. Also, parents in the middle and upper socio-economic brackets have more contacts with business and professional people, who are likely to hire their children.

Academic Performance Related to School Attendance

Two measures were used to determine whether or not there was a relationship between academic performance and school attendance: the number of grades repeated and the usual grade average. Only 1 per cent of the youths in school had repeated as many as two grades, but over one-fourth (26 per cent) of the drop-outs had had to repeat two or more grades. At the other extreme, more than four-fifths of the youths in school had not repeated a single grade, but just one-third (35 per cent) of the drop-outs had fared as well. (See Table 13.)

The same pattern persists in terms of grades received. Two-fifths (39 per cent) of the drop-outs reported average grades of D or less, but only

TABLE 13.—School Attendance Related to Academic Performance

Measure of Academic Performance	Youths in School		Drop-outs	
	Number	*Per Cent*	*Number*	*Per Cent*
Grades repeated:*				
None	302	83	23	35
One	58	16	26	39
Two or more	5	1	17	26
TOTAL	365	100	66	100
Usual grade average:*				
B or above	150	41	10	15
C	185	51	31	46
D or less	28	8	25	39
TOTAL	363	100	66	100

*Differences between youths in school and drop-outs are statistically significant at the .01 level as measured by the chi square test.

8 per cent of the youths in school had such low grades. In contrast, 41 per cent of the youths in school but only 15 per cent of the drop-outs maintained a B average or higher. (See Table 13.)

Grades, of course, can be indicators of more basic academic problems, such as low intelligence levels. They serve, also, to measure the adjustment of the individual to the school situation. The fact that the majority of the drop-outs were making what might be termed satisfactory grades suggests that factors other than lack of mental ability relate to school attendance. Too, it should be remembered that an over-all average does not point out difficulty which may have been experienced in a particular subject matter field.

In terms of the school environment, it can be assumed that drop-outs had not made as good an adjustment as non-drop-outs to their studies. It also seems clear that intelligence factors were not the sole factor operative in holding academic ratings down. The logical conclusion is that many students did poorly because of apathy or lack of encouragement in the home or at school.

Participation in School Organizations Related to School Attendance

The data collected show that participation in school organizations is significantly related to school attendance. School clubs and organizations of various types are an important part of school life. Therefore, it could be expected that those students who take part in them would more likely be better adjusted in the school situation. At the same time, when students are rejected from these associations, or when the associations do not represent pleasant experiences to them, it can be expected that the student will lose interest in school to some extent.

TABLE 14.—School Attendance Related to Youths' Participation in School Organizations

Offices Held in School Organizations*	Youths in School		Drop-outs	
	Number	*Per Cent*	*Number*	*Per Cent*
None	238	65	63	93
1-2	114	30	5	7
2 or more	16	5	0	0
TOTALS	268	100	68	100

*Differences between youths in school and drop-outs are statistically significant at the .01 level as measured by the chi square test.

Mere membership in an organization was not considered a sufficient test of participation, because many clubs in school have a blanket membership. Youths interviewed were therefore not only asked how many clubs they belonged to, but how many offices they had held in these clubs. This line of questioning gave some insight of the way they were accepted by their fellow students and also of their leadership qualities.

The findings of the study show that a significantly larger percentage of drop-outs than of non-drop-outs (93 as compared with 65) did not hold office in a single organization while in school. In contrast, as many as 30 per cent of the youths still in school were officers in one or two organizations but only 7 per cent of the drop-outs had been officers in one or two groups. Five per cent of the youths in school, but no drop-outs, had held three or more officerships. (See Table 14.)

It may be deduced from the above that drop-outs are less likely to be chosen officers of their school organizations because they do not measure up to certain requirements (norms) considered necessary for such participation. Insofar as these norms represent values of the school as an ongoing social system, they tend to make the system discriminate against certain individuals.

Youths' Attitude Toward a High School Education Related to School Attendance

Youths still in school have a significantly greater appreciation of the advantages of a high school education than do drop-outs. When asked how much of a disadvantage they felt the lack of a high school education would be, over four-fifths of the youths in school (81 per cent) answered, "great." Only two-fifths (39 per cent) of the drop-outs gave this response. At the other extreme, only 3 per cent of the in-school youths, but 26 per cent of the drop-outs, voiced the opinion that a person without a high school education would have little or no disadvantage in life. One-sixth (16 per cent) of the in-school youths and one-third (35 per cent) of the drop-outs expressed the feeling that the person without a high school education would be moderately handicapped. (See Table 15.)

It is not surprising that a negative attitude toward a high school education should be closely correlated with school attendance. In the first place, such an attitude would reflect a rationalization of what they had actually done. Such an attitude would effectively serve to promote lack of interest in school. However, it also would indicate that the individual was pre-conditioned by his reference groups to place little value on the worth of schooling. In this regard, the school did not get the student to change his views to ones more in keeping with the educational values of the greater society. Perhaps this is an area where educators have a challenge. Certainly, ways could be devised to detect attitudes such as the above and special instructions could be planned for youths who enter school with attitudes definitely negative toward education.

At this point, it is of interest to note that only 4 drop-outs had had any educational experience since leaving school. In each instance, a trade or vocational school had been attended. Approximately two-fifths (38 per cent) of the drop-outs indicated that they had some educational plans for the future. Vocational schools were named as the type of school in mind in each case. The latter suggests that firsthand contact with the job market had forced home the realization of the need for some type of skill.

TABLE 15.—School Attendance Related to Attitude Toward a High School Education

Attitude Statement	Youths in School		Drop-outs	
	Number	*Per Cent*	*Number*	*Per Cent*
How much of a disadvantage is a lack of a high school education?*				
Great	286	81	26	39
Moderate	55	16	23	35
Little or none	13	3	17	26
TOTAL	354	100	66	100

*Differences between youths in school and drop-outs are statistically significant at the .01 level as measured by the chi square test.

Interpersonal Factors and School Attendance

Previous investigations have concluded that certain interpersonal factors weigh heavily in the adjustment of individuals and groups to social situations. Consequently, the youths interviewed were asked three questions to determine how well they were getting along with their fellows in the classroom. Their responses to each question are summarized in the discussion which follows.

The data collected suggests that many drop-outs feel that rural students are rejected by town students. As many as one-fourth of them said that they were aware of a "feeling" between the two groups. One drop-out summarized the opinions of those who gave responses of this type by saying, "they (town students) think they're the most." Although only 10 per cent of the youths in school said they thought there was some feeling between town and country students, this percentage is large enough to indicate an awareness of "feeling" along this line. Also, it is possible, in the light of observations made, that some interviewees hesitated to affirm the presence of ill-feeling between classes of students.

It should not be overlooked that the majority of the drop-outs, as well as of students still in school, could see no antagonism or rejection between the two groups. However, the fact that such a feeling is significantly related to school attendance indicates the importance of this factor. (See Table 16.) It may be noted that interviewers were especially aware of feelings of this type at certain schools. Perhaps the problem is more or less localized in nature. Nevertheless, the fact that it does exist at all is important from the standpoint of this study.

The second question asked related to the ease with which friends were made. Almost all the youths interviewed said they found it easy to make friends. In fact, there was no significant difference in the responses of drop-outs and non-drop-outs. The same percentage of both groups (94 per cent) said they made friends easily.

TABLE 16.—School Attendance Related to Selected Aspects of Adjustment in School

Selected Statements	Youths in School		Drop-outs	
	Number	*Per Cent*	*Number*	*Per Cent*
Do you notice any feeling between rural and town students?*				
Yes	32	10	16	24
No	280	90	50	76
TOTAL	312	100	66	100
Do you find it easy to make friends?				
Yes	346	94	62	94
No	22	6	4	6
TOTAL	368	100	66	100
Do you find it easy to recite in class?				
Yes	198	54	33	50
No	170	46	33	50
TOTAL	368	100	66	100

*Differences between youths in school and drop-outs are statistically significant at the .01 level as measured by the chi square test.

The youths interviewed were about evenly divided in their responses to the third question, "Do you find it easy to recite in class?" About half of the in-school group (54 per cent) and of the drop-out group (50 per cent) answered yes to this query. This finding suggests that personality traits, such as introvertedness, do not relate especially to the school attendance problem.

Youths' Appraisal of Teachers Related to School Attendance

In the primary planning for this study, it had been surmised that the status-role position of the teacher might not have been completely

TABLE 17.—Youths' Appraisal of Teachers, Related to School Attendance

Appraisal Statements	Youths in School		Drop-outs	
	Number	*Per Cent*	*Number*	*Per Cent*
Number of teachers interested in student:				
All	83	23	25	38
Most	200	54	26	39
Few	85	23	13	20
None	0	0	2	3
TOTAL	368	100	66	100
Number of teachers fair to students:				
All	79	22	25	38
Most	229	62	32	49
Few	58	16	7	11
None	1	0	1	2
TOTAL	367	100	65	100
Feeling toward teachers:				
Liked most	283	77	55	83
Disliked most	9	3	4	6
No special feeling	75	20	7	11
TOTAL	367	100	66	100

understood or appreciated by some students. Also, it was felt that the teaching policies of certain schools might tend to antagonize youths with particular personality traits. Therefore, all youths queried were asked three questions: Are, or were, the teachers in your school interested in students? Are, or were, the teachers in your school fair to the students? What are, or were, your feelings toward your teachers?

The analysis of the data pertaining to these questions shows no significant difference between the responses of drop-outs and non-drop-outs. In each instance the large majority of both groups gave answers judged favorable; that is, they thought most teachers were interested in students, were fair, and they liked most of them. Detailed tabulations of the responses for each question may be seen in Table 17.

Occupational Aspirations of Youths Related to School Attendance

Each of the youths interviewed was asked what he hoped to make his lifetime occupation. This query was designed to see whether youths in school would have higher occupational aspirations than drop-outs. Hypothetically, it was felt that positive educational values would be positively associated with higher occupational ambitions. The responses of boys and girls were tabulated separately because of the nature of status-role differences between the sexes.

The answers given are revealing, although a relatively large percentage of both groups of boys (28 per cent of the youths in school and 19 per cent of the drop-outs) said they didn't know what they wanted to do as a lifework. Over one-third of the boys still in school planned to go into professional or technical work, but only one-twentieth of the drop-outs hoped for such a career. In contrast, only one-fifth of the boys in school, but two-fifths of the drop-outs, were looking forward to jobs as craftsmen. Very few of the boys in school (5 per cent) wanted to be farmers; however, one out of every five drop-outs had this type of work in mind. The findings reflect a trend which is of growing concern to persons interested in the future of agriculture.

The contrast in occupational aspirations is even more apparent in the instances of the girls. Almost all drop-outs (85 per cent) were planning to be housewives. By comparison, over one-fourth of the girls in school wanted to do some kind of professional or technical work and three-tenths of them were planning to be secretaries. Only 15 per cent said they were looking forward to being housewives. (See Table 18.) The comment may be made that the schools tend to play down the role of

TABLE 18.—School Attendance Related to Occupational Aspirations of Youths, by Sex

Aspirations	Youths in School				Drop-outs			
	Male		Female		Male		Female	
	No.	*Per Cent*	*No.*	*Per Cent*	*No.*	*Per Cent*	*No.*	*Per Cent*
Lifetime occupation desired:								
Professional, technical, and kindred occupation	62	36	55	28	3	10	2	6
Farming	9	5	0	0	6	19	0	0
Craftsman, foreman, and kindred occupation	34	20	5	3	13	42	1	3
Service	9	5	15	8	1	3	0	0
Secretarial	0	0	61	31	0	0	0	0
Housewife	0	0	29	15	0	0	30	85
Other	11	6	3	2	2	6	0	0
Don't know	49	28	26	13	6	19	2	6
TOTAL	174	100	194	100	31	100	35	100

wife and mother, a fact which has been taken cognizance of in recent years.

It can be concluded from the above findings that those youths dropping out of school are looking forward to different life careers than those who stay in school. This finding supports the thesis that educational values and occupational aspirations are closely connected.

At this point it is interesting to note the present employment of drop-outs. Of the 31 boys involved, 3 were farm laborers, 4 were in some sort of service work, 4 were craftsmen, and the remainder were not working for pay. Only 5 of the 35 girls were working, and all 5 were in service work.

FIELD NOTES AND OBSERVATIONS

Conferences were held with the superintendents, principals, and certain teachers of the schools studied. These sessions were arranged in order to obtain insights which might not be obtained in other ways. In addition, interviewers were asked to report their impressions and observations of the homes of youths in school and of drop-outs, as they went about their regular business of interviewing. The notes and observations derived from the above are summarized in this section.

Observations Relating to Home and Family Life

The home situation of drop-outs, as compared with non-drop-outs, seemed to the researchers to be revealing in many ways. There were, of course, manifestations of higher socio-economic and educational levels in the homes of the latter. The first impression is that, in some ways, the typical drop-out family was harder to approach than the typical non-drop-out family. (This was more true in one sample parish than the other.) However, once the "ice" was broken almost all interviewees proved cooperative. The drop-out families tended to be more difficult to interview in the sense that they frequently engaged in long discourses "against" certain state or national government officials.

A second impression was that the homes of drop-outs appeared generally to be less well kept. One interviewer stated it was not unusual for him to have to thread his way through assorted debris to reach the house, which was usually unpainted and in poor state of repair. (This condition was also more prevalent in one of the sample areas than in the other.)

Another generalized impression of the drop-out families is that they seem much more dissatisfied with their lot and to be obsessed with a feeling of pessimism. The observation was made that the music found in the local juke boxes of one of the areas seemed to express the mood of unhappiness and insecurity found in some of these homes. Such titles as, "If I Had the Wings of an Angel," "I Cry a Tear," "Walking Alone," and "Tears on My Pillow" had great popularity.

The families of drop-outs did not evince, overtly or covertly, values which could be construed as stressing educational or occupational achievement. Rather, the idea seemed to be encouraged that too much education was a useless waste of time and that schools were a subversive influence in many ways. Statements were made to the effect that children learned "laziness" in school and that the subjects the school taught were not practical.

Parents of drop-outs demonstrated much less interest in school activities and programs than did parents of youths in school. In fact, the former seemed to have only the vaguest notion of the school as an ongoing system.

A comparison of comments of parents of the two sample groups of youths suggests that drop-out families have lower occupational aspirations. They tended to give the impression that a good "public" job (meaning wage work of some kind) was about as much as one could expect, in terms of both status and income. On the other hand, families of youths still in school more often cited professional and proprietorial positions as desirable.

Observations Relating to School Life

There was a considerable range in the physical plants and the operation of the eight schools studied. Observations concerning them are necessarily brief and summary in form.

The schools studied were small and faced with a decreasing enrollment related to population decline. Some "threats" of consolidation had been heard at almost every school and possibly this fact occasioned an initial suspicion of the researchers on the part of certain principals and teachers. These reactions soon changed when it became evident the study was not concerned with local affairs.

Observations related to the school are helpful in understanding the drop-out problem in many ways. The frank replies of principals and teachers reveal certain situations which they recognized as contributing to the above problem, but for which they had no solution. The basic situations may be described as follows.

Frequently, children from the lower income families attend elementary schools separated from the high schools or else their parents move into the area at about the time their children are ready for high school. Consequently, these youths have difficulty becoming integrated into the schools' programs. Students who have come up through the grades in the same schools have their own cliques and interest groups, and tend to shut out the newcomers.

The second factor which apparently enters the picture is the social distance which separates the low-income, lower class student from the middle and upper class student. This situation may be described briefly as follows. The lower-income student comes to school with certain highly visible symbols of his lower status background. His clothes are not quite up to the standard expected, nor is his speech or his manners. In addition he may not exhibit all the habits of cleanliness which have come to be commonly accepted in local "middle class" circles. Over-all, he has internalized a set of values which in certain particulars differs quite radically from the "norms" of the school set. To illustrate, one principal remarked that this class of youth was not interested in the schools' social, athletic, or musical programs and that all they could think about was hunting and fishing.

What happens to the lower-income student with his apparently "lower" standards in the high school situation? First, he is rejected to some degree by his fellow students. This is apparent in his being given less opportunity to participate in their school or home social activities. Second, some of his teachers discriminate against him, intentionally or unintentionally, because he is also judged by them according to "middle-class" standards and expectations. It is possibly no reflection on the teacher that she "gives up" rather easily on the boy or girl whose speech defects are "so" pronounced, whose educational background leaves so much lacking, who perhaps does not exhibit certain common courtesies, and whose father might be known for his "shiftlessness."

Faced with a school climate as described above, it is easy to see how certain students develop a feeling of insecurity and even resentment. In fact, the expected pattern would be one of aggressively seeking for recognition through violation of certain school norms. Actually, drop-outs were occasionally characterized as "trouble makers" whom the school was glad to see leave.

On the other side of the picture, examples were brought to the attention of the interviewers showing that school situations had been such as to bring out the latent abilities of youngsters from lower class homes. One vocational agriculture teacher took a great deal of pride in relating how he had obtained jobs as welders for 21 of "his" boys. There was indication that vocational agriculture teachers had more success with low-income students, possibly because of their subject matter (especially the craft skills taught), and because of their work with the parents of the children.

At this point, it is of interest to report a comment of certain parents of drop-outs. They felt that vocational courses should be taught before high school because so many boys tended to drop out at 16, just about the time they passed to high school.

The above are some of the subjective observations derived from the study. The insights obtained are important in that they help explain the "whys" of the drop-out problem.

SUMMARY AND CONCLUSIONS

This investigation was conducted to evaluate some factors affecting the attainment in school of rural youth. Information for the study was obtained from personal interviews with the junior and senior students in eight carefully selected high schools, with youths 16-19 years of age who had dropped out of these high schools, and with the parents of both groups of youths. In addition, personal conferences were held with the principals and certain teachers at the sample schools. The hypothetical premise for the study was that the rural school drop-out problem could be explained in terms of certain environmental factors relating to the family and to the school. The following summary of the findings is organized according to the major divisions of the study.

Summary

The first concern of the study was to determine why rural youths dropped out of school. To this end, all drop-outs were asked why they quit school. By far the largest number dropped out because of lack of interest. Marriage was the second most important reason given, but this reason was almost exclusively given by girls. Other stated reasons included: needed at home, finances, and health. Interestingly, the parents of drop-outs and the principals of the sample schools gave essentially the same reasons as did the youths, when asked why the drop-outs had left school.

The investigation indicated that certain factors associated with the home and family environment were closely related to school attendance. Drop-outs' families differed from non-drop-outs' families as follows: From an occupational standpoint, the fathers of drop-outs were more likely to be farmers than non-farmers, farm laborers than farm operators, and doing wage work rather than professional or technical work. The educational attainment of the fathers and mothers of drop-outs was far less than that of the fathers and mothers of youths still in school. Also, the parents of drop-outs participated less in school activities, and placed a lower value on a high school education than did the parents of youths in school.

Several questions posed to each group of interviewees were designed to see whether or not the school environment of youths was related to school attendance. Distance between school and home was determined to be significantly associated with school attendance. Drop-outs were more likely to use public school buses for transportation to school. It was also discovered that youths in school had more gainful employment experience than drop-outs. The grades of drop-outs were found to be considerably lower, and they had failed more grades. Drop-outs also took part in fewer school activities and were less likely to be officers in the school organizations to which they belonged.

A considerable number of drop-outs and some youths still in school said they were aware of a "feeling" between town and country students. However, this type of reaction seemed to be localized in one or two of the schools. About half of both groups admitted they found it difficult to recite in class. The majority of both groups thought most of the teachers were interested in the students and were fair to them. Almost all youths questioned liked most of their teachers.

Personal interviews with youths determined that boys and girls still in school differed in occupational aspirations from the drop-outs. The occupational aspirations of boys still in school tended toward professional and technical positions, while boys who had dropped out of school were interested in craft-type jobs. Most girls still in school wanted to become professionals or do secretarial work, while girls who had dropped out of school generally wanted to be housewives.

Other findings of the study are of interest but do not seem to be causally related to the drop-out problem. About half of the parents interviewed thought the high schools should offer more vocational courses, although there was no significant difference in the opinions of parents of drop-outs and non-drop-outs on this score. The majority of both groups of parents felt their children received about the right amount of homework and that the schools provided about the right amount of recreation. Parents were about equally divided in their opinions regarding the need for improving their local schools and on whether or not the people of their communities were interested in their schools. About half of both groups of parents replied that keeping their children in school had been a financial burden.

Interviewers were asked to report their impressions of the homes and schools they visited in an effort to supplement the objective findings of the study with subjective information. A summary of these reports indicated that drop-outs tended to live in poorer homes. Their parents seemed to be more antagonistic toward the "government," to value education less, and to have less interest in community schools.

Observations made at the sample schools indicate that lower income students frequently find themselves in a social situation with which they cannot successfully cope. They are expected by their teachers and peers to adhere to standards of behavior and aspirations which are foreign to what they have learned in their homes. The result is a feeling of rejection and insecurity and, not infrequently, the development of an aggressive antagonism. In this way the schools may be said to discourage attendance.

Conclusions

Findings of this study leave little doubt that educational attainment in rural areas (as well as urban areas) is closely related to environmental factors, and is a two-fold problem of social adjustment. This phenomenon is explained in terms of the theoretical concept of the social system. Each family and each school is an ongoing system with certain goals and value orientations and certain norms of expected behavior. In the first instance, the family as a social system sets certain standards of behavior for its members. To be adjusted, family members must internalize the values of the family. Those members who subscribe to a different set of values tend to become suspect and to be regarded as misfits. Since everyone strives to "belong," especially in his family group, it is easy to see how there is little or no incentive for youths in some homes to continue schooling. To be too ambitious in this direction is to appear to want to become "better" than one's family, etc. Conversely, in a family that stresses education as a value, a "good" adjustment is one that includes high educational attainment. In this instance, dropping out of school represents a maladjustment.

The second adjustment problem centers in the school situation. Again, it is a matter of feeling wanted and secure. Where distance prevents close ties with the school, or where standards of behavior are expected or demanded which are strange to certain youngsters, they will adjust by dropping out of school as soon as possible. This is especially true if all means of achieving recognition are removed and a "social distance" set up which excludes one from informal types of participation.

In contrast, where the student's problems are understood and a deliberate effort is made to satisfy his socio-psychological needs as well as his educational needs, he will tend to feel "adjusted" in the school situation. In fact, a good adjustment at school may overcome the handicaps of a poor home environment insofar as school achievement is concerned.

Obviously the above findings represent a serious problem to all U.S. citizens. The nation is losing a considerable amount of talent in the sense that many capable rural youths are not receiving the benefits of advanced education. National progress may be said to be hampered in direct proportion to the loss of this talent.

Certain clues for meeting the challenge may be derived from the present study. A starting place for action programs is suggested by the finding that negative educational values in rural homes are largely reponsible for biasing the educational opportunities of youth. Perhaps ore attention should be devoted to "selling" education to rural families. ertainly, it makes as much sense to promote the education of youth, as human resource, as it does to encourage practices leading to higher ields of crops and livestock. At the same time, school officials should e made acutely aware of the special handicaps of children from lower-come homes. These are not easy solutions.

Self-Feeding Bunker Silos

by WILEY D. POOLE

Bulletin No. 534 May 1960

Louisiana State University
and
Agricultural and Mechanical College
Agricultural Experiment Station
Charles W. Upp, Director

Contents

Page
Introduction 5
Locating the Silo 5
ize and Capacity 6
Construction 9
  Floor 9
  Walls 9
Self-Feeding Gates 17
Filling and Packing 18
Covering the Silage 22
Notes on Making Good Silage 22
Literature Cited 23

Self-Feeding Bunker Silos

WILEY D. POOLE
Agricultural Engineer

Introduction

Competitive markets for both dairy and beef products, together with a shortage of farm labor, have resulted in the farmer's seeking better and more economical means of feeding livestock. These economic factors have been responsible for the mass movement of southern stock farmers to better grassland farming. In the South, certain grasses and legumes can be grown in abundance in early spring when the frequency of rains and damp ground makes field curing of hay practically impossible. In such cases the feed can be saved as silage. Properly prepared and stored, silage has always been recognized as an excellent food, but by and large, the southern stock farm has failed to take advantage of feeding silage because of the investment involved and the labor required for feeding it. This particularly applies to beef cattle farmers.

Experiments were conducted to seek a suitable low cost method of storing and feeding silage in the South where the land is practically flat and rather poorly drained. The above-ground bunker silo is a result of these tests. Many of the early experiments resulted in high dry matter losses as compared to losses with the conventional upright silo long in use by the more progressive dairy farmers. However, as better filling and packing methods were introduced, as well as improved silo construction, these losses from bunker silos were reduced until they compared favorably with losses from other accepted methods of storing silage.

The above-ground bunker type silo appealed to the stock farmer because of its low cost construction, large capacity, adaptability to feeding and field locations, handling methods and self-feeding. Bunker silos are well adapted for use in the flat coastal areas where high water tables make trench silos impracticable. They can be conveniently located in the areas where the feeding is done. The decision to build a bunker silo should be based on these factors but should also take into consideration that very high spoilage losses can be expected with poor handling and management practices.

Locating the Silo

The bunker silo should be placed on a spot that is as well drained as possible in the area where it is to be located. The site should be easily accessible both to the fields where the ensilage is grown and to the pastures where the cattle will be fed. Many farm ers have located large-capacity silos that are to be self-fed across fence line dividing two pastures so that they can self-feed each en of the silo from a different pasture. Drainage at the site is ver

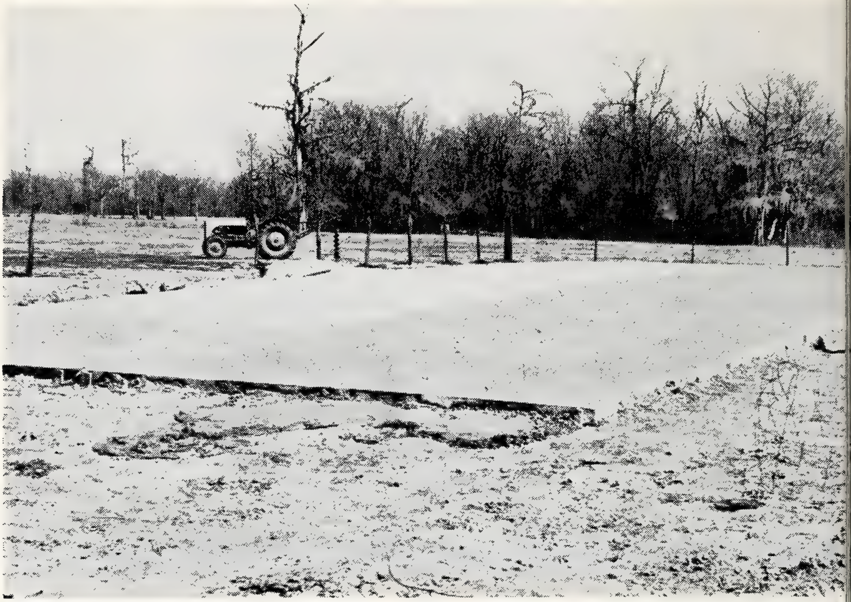


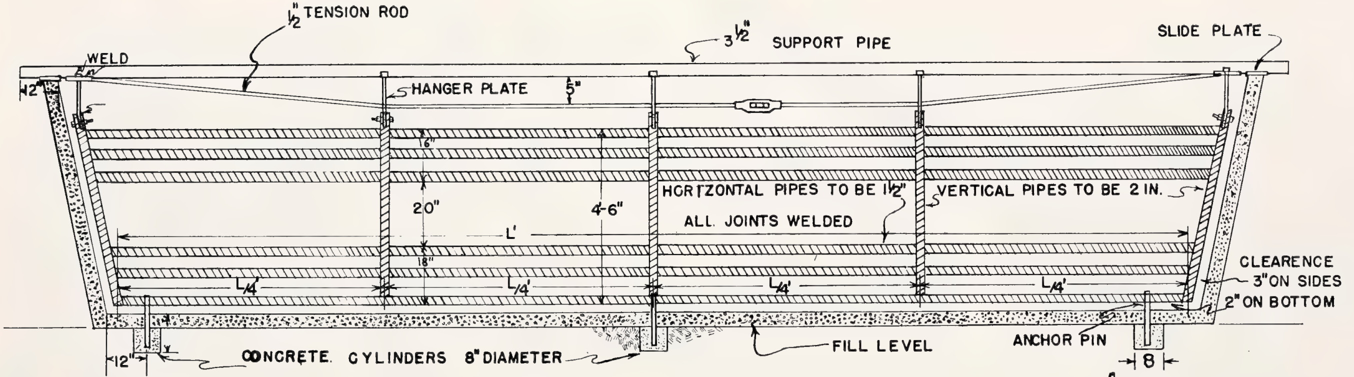
Fig. 1.—Floor slab poured for a bunker silo on a slight ridge in normal flat land.

important since seepage from the silo, as well as rain water, mu be drained away. Rain water should not enter the silo, and a drai age or diversion ditch should be made on both ends and sides of th silo.

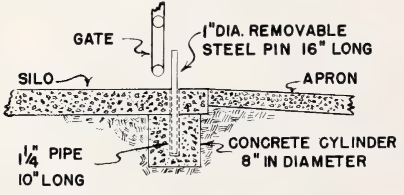
Do not place the bunker silo with either end next to a buildin row of trees, or a ditch, since ample room must be allowed to turn c leaving or entering the silo. Figure 1 shows a floor slab pour for a bunker type silo on a slight crown of the land in an area th is normally flat.

Size and Capacity

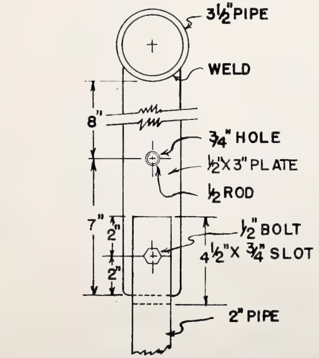
The over-all size of a bunker silo to build will be governed by th size of the herd to be fed. If the silage is to be self-fed, the widt of the silo would depend on the size of the herd in that pastu where the silo is located. In many instances one silo will be use to feed cattle from two pastures by feeding from both ends of th silo. Other factors determining the required size of the silo are th amount of silage fed daily and the length of the feeding period.



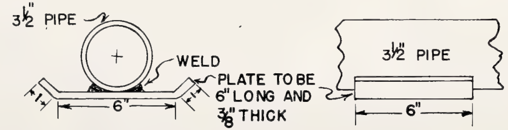
FACE VIEW OF GATE
SCALE: ½" = 1'-0"


GATE
1" DIA. REMOVABLE STEEL PIN 16" LONG
SILO
APRON
1¼" PIPE 10" LONG
CONCRETE CYLINDER 8" IN DIAMETER

ANCHOR PIN DETAIL
SCALE: 1" = 1'-0"



HANGER PLATE DETAIL
SCALE: ¼" = 1"



SLIDE PLATE DETAIL
SCALE: ¼" = 1"

The self-feeding gate shown in Fig. 2 is designed to allow tw cows to feed from this gate for each foot of silo width where th have free access to the silo at all times. To prevent the width fro becoming overly large for big herds, it is recommended to fe from both ends of the silo. A silo narrower than 10 feet is n recommended. For self-feeding, the side walls of the silo shou not be taller than 6 feet and the silage should have a crown of 2 to 2½ feet in the middle after packing. This will give a cent height of approximately 8 feet, which is as high as an animal ca reach while feeding. Silos with side walls of 8 to 10 feet are sa isfactory where the silage is to be hauled from the silo and not se fed.

In arriving at the over-all size of a self-feeding silo for a giv herd, assume that the average animal will consume approximate 60 pounds of silage per day and that the silage weighs 40 pounds p cubic foot. The number of days that the cattle will be fed fro the silo will govern the desired length of the silo. The beef catt farmer along the coastal area usually plans on having to feed fro silos from 100 to 120 days during the winter months. With this a basis, the size of the silo can be determined. For example, a si 20 feet wide should feed 40 cows from one end, and they will co sume 60 pounds of feed per cow per day for a period of 120 day The silage required would be 40 x 60 x 120 = 288,000 lbs., or 14 tons. A silo of this size will have an approximate capacity of 5,80 pounds per foot of length, so the length will have to be about 5 feet. If the silo is to feed 40 cows from each end, then the length w have to be 100 feet. The approximate capacities of silos of vario widths and lengths are given in Table I.

Table I.—Approximate Capacities of Silos of Various Widths and Lengt

FEEDING PERIOD		120 DAYS	160 DAYS	200 DAYS	Capaci for Ea 4 Fee of Len
Herd Size	Width of Silo	Length of Silo 60 Ft.	80 Ft.	100 Ft.	
24 head	12 ft.	86 tons	115 tons	144 tons	5.7 to
28 head	14 ft.	100 tons	134 tons	168 tons	6.7 to
32 head	16 ft.	115 tons	153 tons	192 tons	7.7 to
40 head	20 ft.	144 tons	192 tons	240 tons	9.6 to
48 head	24 ft.	172 tons	230 tons	288 tons	11.5 to
60 head	30 ft.	216 tons	288 tons	360 tons	14.4 to

1. Capacity is based on silage weight of 40 lbs. per cubic foot and settled depth of 6 fe except at ends.

2. Width of silo is based on herd size and on an average consumption of 60 lbs. of sil per animal per day.

3. Length of silo based on 6" daily rate of use for warm weather conditions. Length may varied in units of 4 feet.

Construction

The above-ground bunker type silo must be built rigid and strong to withstand the heavy packing loads required for preserving good silage. Materials used should be capable of withstanding weather and silage juices.

Floor

The bunker silo floor must be made of some material that will not soften from wet weather and silage juices. The floors of a self-feeding silo must also withstand the constant wear and tear from cattle hoofs. A silo without a hard floor cannot be self-fed from, nor hauled out of, because it will be a mud puddle as soon as it is opened for use. Concrete or asphalt makes the best floors, although treated timber can be used. Concrete is usually easier than asphalt for the farmer to use since it requires no special machinery. Figure 1 shows a concrete floor just after pouring. Concrete floors should be from 4 to 5 inches thick and a No. 9-6 x 6 wire mesh reinforcement is advisable. For asphalt floors a thickness of 4 inches laid over a well packed and rolled soil subbase 6 inches thick is advisable. The floor must be sloped to the open end of the silo in order to drain rain water, silage juices and manure away from the silage. If both ends are to be self-feeding, then the floor must be sloped from the center of the silo to each open end. The slope should be from ⅜ to ½ inch per foot of silo length. If the silo is located on the crest of a slight ridge, then the slope to the open ends can usually be obtained without filling. The silo floor shown in Fig. 1 is located across the crest of a ridge and will be self-feeding from both ends. Some designs show the floor sloping from the center to the sides in addition to sloping to the ends. If the proper slope to the open ends is maintained the side slope can be eliminated. If the silage is to be fed out by hand or mechanically, then a slope of ¼ inch per foot is satisfactory.

An apron on each end of the silo made of the same material as the floor and extending out from 16 to 18 feet is highly recommended. This is to prevent the cattle from creating a muddy condition at the entrance of the silo and also serves as a place for turning the packing tractor while loading the silo.

Walls

There are many materials that can be used for the silo side walls. The type used will be governed somewhat by the cost and availability of the materials in each locality. The wall construction must be strong enough to withstand the loads imposed upon it by the silage, plus the packing tractor and silage wagons while filling. Research work conducted by Esmay (1) and Poole (2) indicates that the greatest stress on the side walls occurs while the silage is

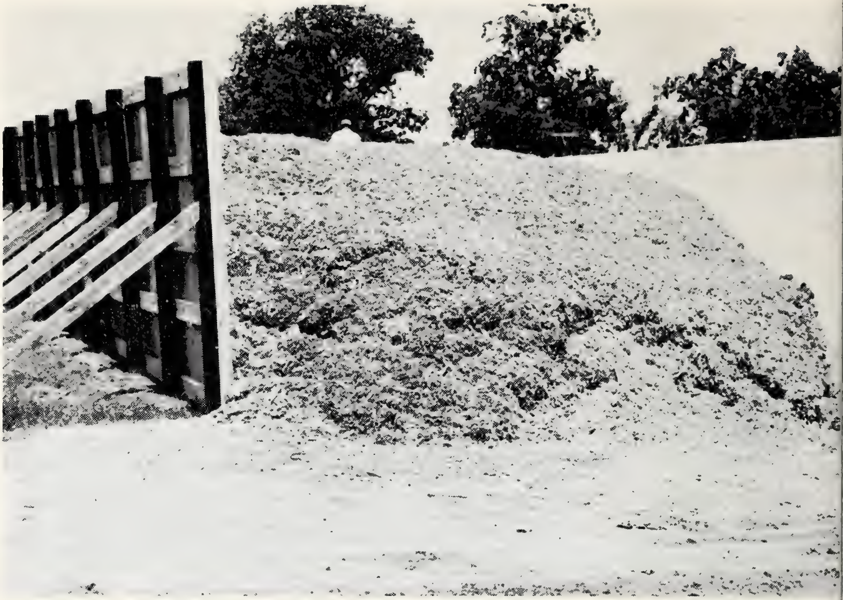


Fig. 3.—A test silo to determine the suitability of side wall materials

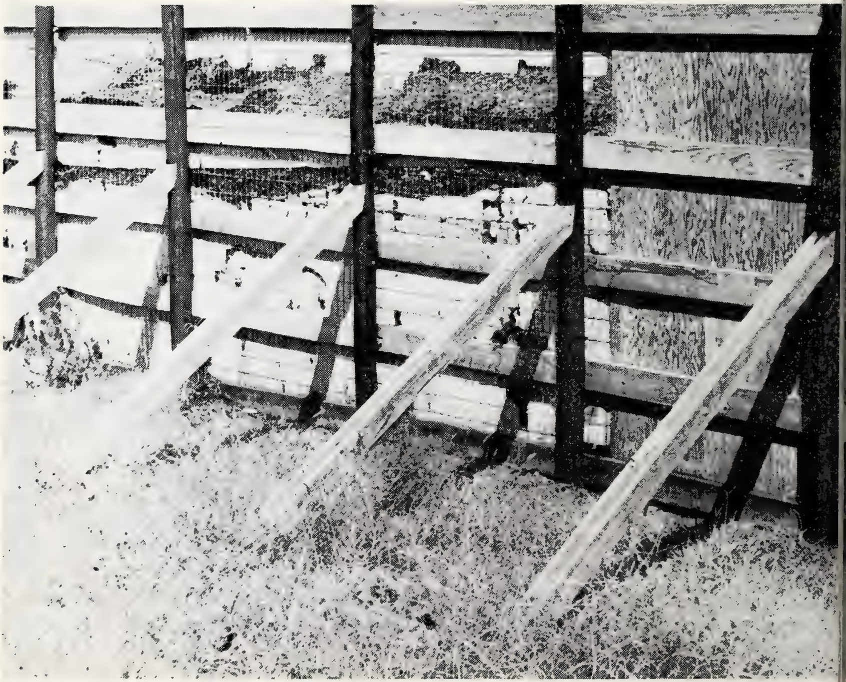


**Fig. 4.—Side wall materials for silo. Right: exterior plywood. Left: weld
wire with waterproof paper covering.**

being packed. This side wall pressure ranges from 150 to 220 pounds per square foot as the packing tractor packs the silage next to the side walls. After packing, this side wall pressure is reduced to approximately 100 pounds per square foot. Pressure on the side walls will increase for a given vertical pressure as the angle or slope of the side wall increases. Therefore, the slope of the side walls should not be greater than necessary to assure good uniform packing along the side walls. A side wall slope of 12 inches for an 8-foot side or 9 inches for a 6-foot side is recommended.

The walls may be made of earth, concrete, treated lumber, exterior plywood, or perhaps other materials that may be economically available and which will withstand the pressures and weathering. Figure 3 shows a test silo at Louisiana State University that was constructed and used to determine the suitability of the various side wall materials. Materials tested under actual operating conditions on this silo were exterior fir plywood, welded wire and waterproof paper, corrugated asbestos roofing, treated timber and concrete staves. Of all the materials tested only the welded wire with waterproof paper proved inadequate, as shown in Figure 4.

The correct height for the side walls of the silos has been a controversial question. Some farmers want to get the greatest capacity for a given floor area and make the side walls 8 feet high. This is considered to be too high for self-feeding, requiring more attention since the cattle cannot reach the top. For the best results of self-feeding, it is felt that 6-foot walls are more desirable.

Materials for side walls for bunker type silos are described as follows.

Earth Bank—Many of these have been built with farm tractors. A bulldozer is frequently used and sometimes a dragline. The shape and size of the earth banks are important as they must be sufficiently broad at the base to permit building the bank to a packed settled depth of 6 feet. Allowances must be made for settling even though packing is done while the bank is being built, by

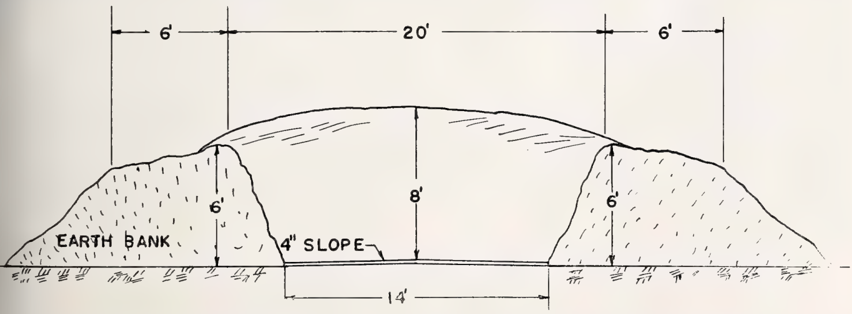


Fig. 5.—Cross section of a typical earth bank bunker silo.

building it higher than the desired settled height. The slope of th earth banks should be 2 feet up for each 1 foot over. The top of th bank should be fairly wide so that a tractor can partly run on while finishing packing the silo. This bank should slope slightly t ward the outside to enable rain water to drain away from the si age. A cross section detail of the earth bank silo is shown in Fig.

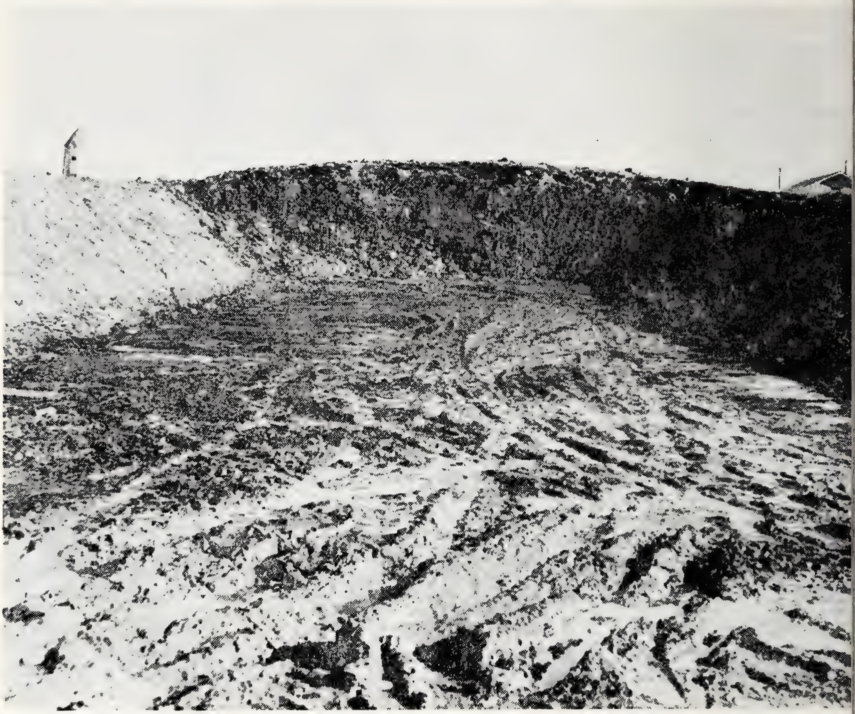


Fig. 6—Earth bank silo where silage is hand loaded into wagons.

To self feed from an earth bank silo, timbers must be placed alon the top of the bank on which the beam will rest for holding the sel feeding gate. A fence must also be installed along the top of th earth bank to prevent cattle from walking on top of the silag Figure 6 shows an earth bank silo where the silage is being haule from the silo.

Tilt-up Concrete Wall—Concrete walls are usually of the tilt-u panel type. The wall panels are 8 feet long and 6 or 8 feet tall an are poured on the silo floor and lifted into place, using a far tractor and a gin pole of some type. Figure 7-A shows the concret panels being poured on the floor of the silo, and Fig. 7-B show the panels in place. This type of construction is very durable wit little or no upkeep costs. Details for this type of construction ar shown in Fig. 8.

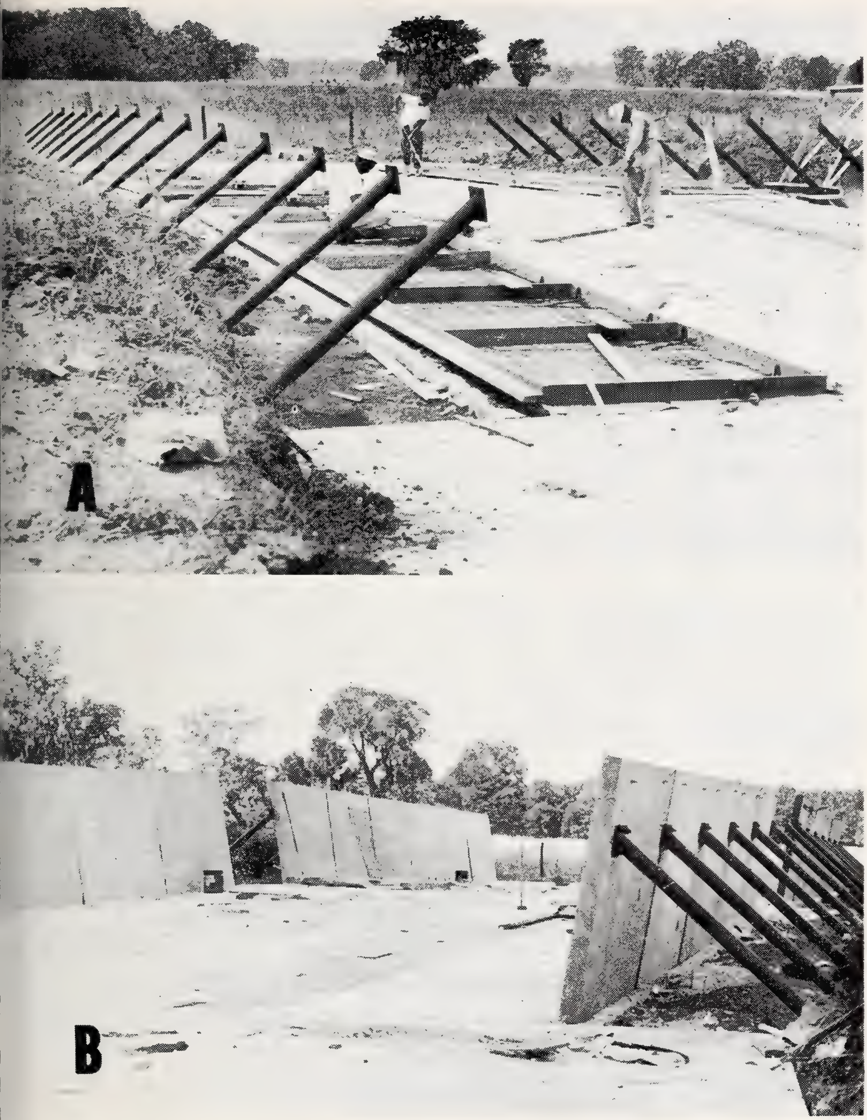


Fig. 7. (A)—Preparing forms for pouring concrete wall panels. (B)—Concrete wall panels in place.

Timber Wall Construction—Pressure treated lumber such as 2" x 8", 2" x 10", etc., preferably T & G, is suitable for side wall material. Figure 9-A shows the details for constructing a timber side wall silo. The cantilever post construction is based on the use of structural grade timbers. It should be noted that the posts are anchored to the slab and the slab is thickened at each post for ad-

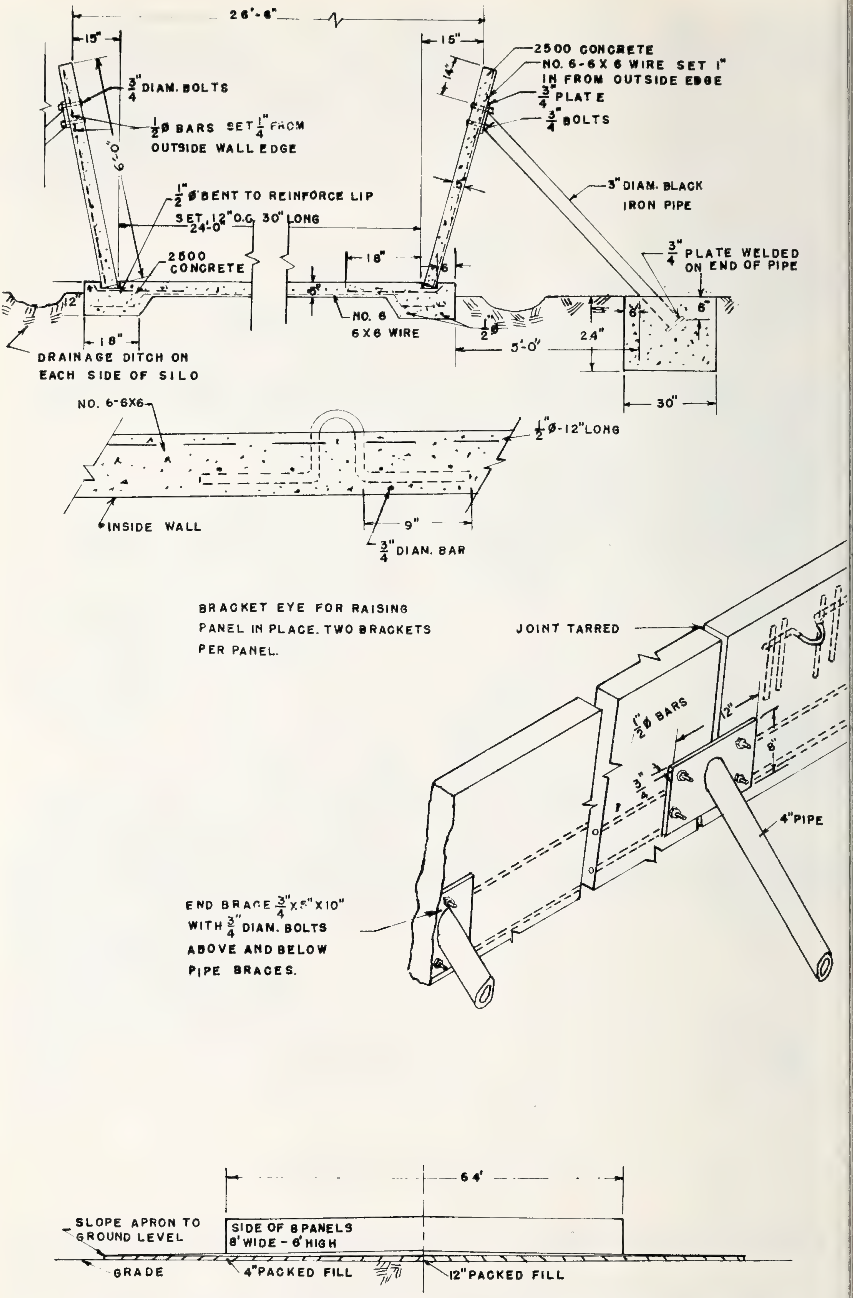

26'-6"
15"
15"
2500 CONCRETE
NO. 6-6 X 6 WIRE SET 1" IN FROM OUTSIDE EDGE
3/4" PLATE
3/4" BOLTS
3/4" DIAM. BOLTS
1/2Ø BARS SET 1/4" FROM OUTSIDE WALL EDGE
6'-0"
14"
5"
3" DIAM. BLACK IRON PIPE
1/2" Ø BENT TO REINFORCE LIP SET 12" O.C. 30" LONG
24'-0"
2500 CONCRETE
18"
6"
3/4" PLATE WELDED ON END OF PIPE
12"
6"
6"
6"
NO. 6 6X6 WIRE
1/2Ø
24"
5'-0"
18"
DRAINAGE DITCH ON EACH SIDE OF SILO
30"
NO. 6-6X6
1/2"Ø-12" LONG
INSIDE WALL
9"
3/4" DIAM. BAR
BRACKET EYE FOR RAISING PANEL IN PLACE. TWO BRACKETS PER PANEL.
JOINT TARRED
1/2"Ø BARS
12"
8"
3/4
4" PIPE
END BRACE 3/4"X5"X10" WITH 3/4" DIAM. BOLTS ABOVE AND BELOW PIPE BRACES.
64'
SLOPE APRON TO GROUND LEVEL
SIDE OF 8 PANELS 8' WIDE - 6' HIGH
GRADE
4" PACKED FILL
12" PACKED FILL

Fig. 8.—Details of construction of a tilt-up concrete wall silo.

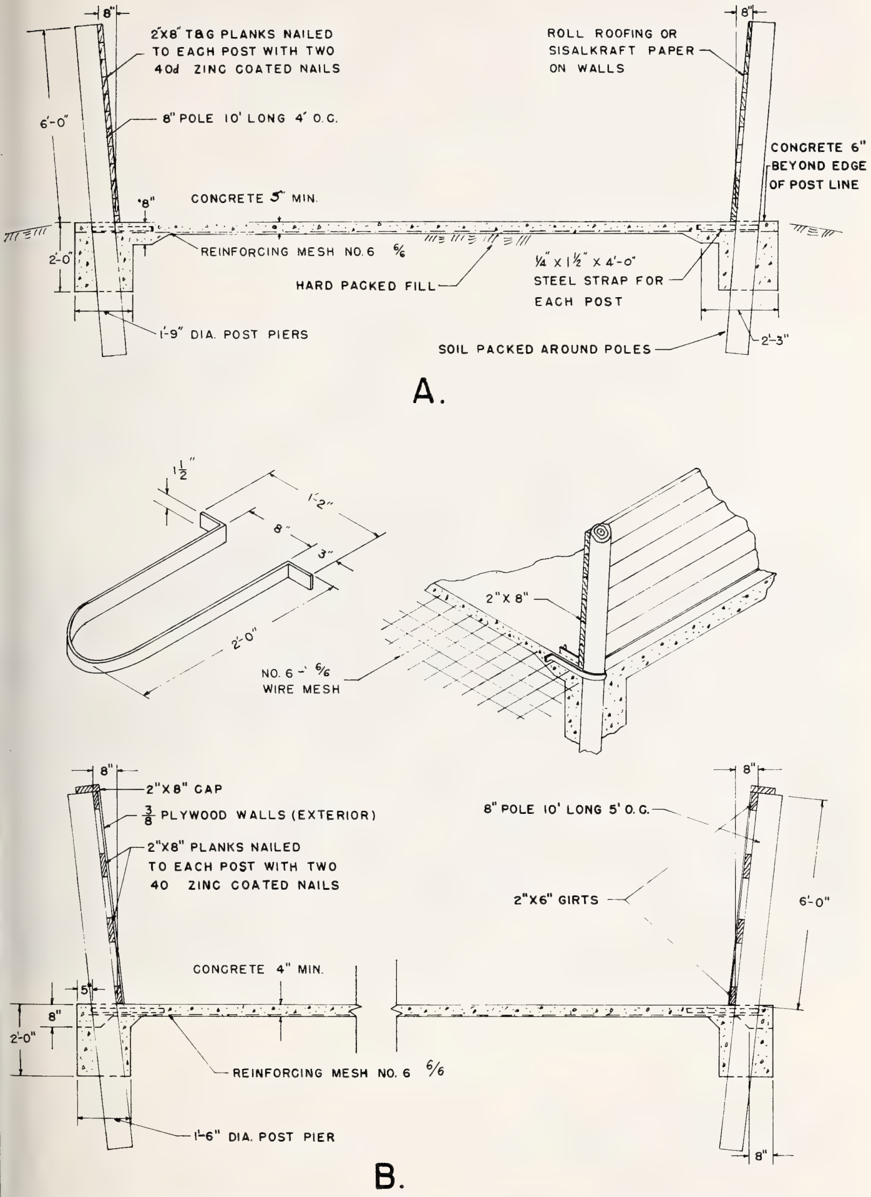

8"
2"X8" T&G PLANKS NAILED TO EACH POST WITH TWO 40d ZINC COATED NAILS
ROLL ROOFING OR SISALKRAFT PAPER ON WALLS
8"
6'-0"
8" POLE 10' LONG 4' O.C.
CONCRETE 6" BEYOND EDGE OF POST LINE
8"
CONCRETE 5" MIN.
2'-0"
REINFORCING MESH NO. 6 6/6
HARD PACKED FILL
1/4" X 1 1/2" X 4'-0" STEEL STRAP FOR EACH POST
1'-9" DIA. POST PIERS
SOIL PACKED AROUND POLES
2'-3"
A.
1 1/2"
1'-2"
8"
3"
2'-0"
2" X 8"
NO. 6 - 6/6 WIRE MESH
8"
2"X8" CAP
3/8 PLYWOOD WALLS (EXTERIOR)
2"X8" PLANKS NAILED TO EACH POST WITH TWO 40 ZINC COATED NAILS
8"
8" POLE 10' LONG 5' O.C.
2"X6" GIRTS
6'-0"
CONCRETE 4" MIN.
5"
8"
2'-0"
REINFORCING MESH NO. 6 6/6
1'-6" DIA. POST PIER
8"
B.

Fig. 9. (A)—Details for constructing a timber wall bunker silo. (B)—Details for constructing a plywood wall bunker silo.

ditional support. If the side wall lumber is tight, such as T & G, th use of a liner of building felt or the like may be eliminated. However, if the boards are uneven and cracks exist in the side wall, i will be necessary to line the silo with some type of waterproof line This material will last only one season.

Plywood as a side wall material has proved very satisfactor Figure 9-B shows the details for constructing such a silo. Plywoo walls eliminate the necessity of using a waterproof paper or buil ers felt liner. The walls should be of 3/8 inch exterior plywoo interior or plyscore grades cannot be used. Surface cracking of th outer ply next to the silage can be prevented by applying a ge erous coat of Penta before filling the silo; however, after four yea of use in a test silo these small surface cracks did not seem to i crease or cause the plywood to deteriorate.

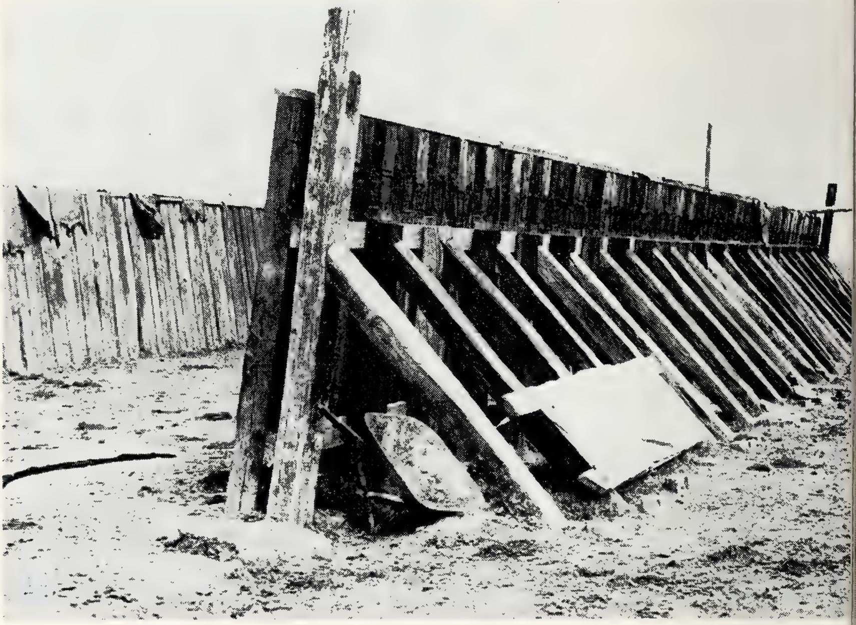


Fig. 10.—Silo of discarded railroad crossties.

Figure 10 shows a timber silo where the walls are made of di carded railroad ties.

Other Side Wall Materials—Corrugated asbestos roofing in bot ¼- and ⅜-inch thicknesses were tested for use as a side wall ma terial. It was found to be excellent in withstanding silage aci and weather. The corrugations gave sufficient rigidity to the ma terial to withstand the lateral pressures and did not noticeabl hinder in any way the packing of the silage. The ¼-inch-thic asbestos was found to be too thin to resist the impact when struck with the unloading or packing machinery, so it is not recommended. The ⅜-inch-thick material was satisfactory. Figure 11 shows one wall of the silo which was tested.

Welded steel wire, 2" x 4", covered with a waterproof paper and/or builders felt was tested as a side wall material. The paper and felt damaged too easily while filling and deteriorated rather rapidly. Cattle also punctured the paper from the outside trying to get at the silage. Damage during test is shown in Fig. 4.

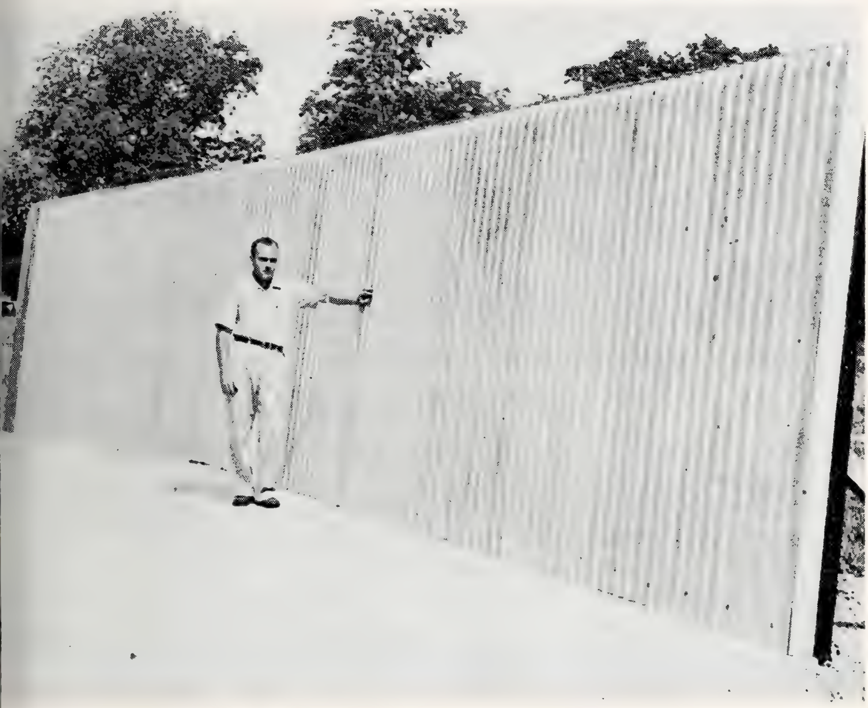


Fig. 11.—A bunker silo wall made of ⅜-inch-thick corrugated asbestos roofing.

One test wall was made of concrete silo staves. These staves were 30 inches long, 11 inches wide and 3 inches thick. Precast pilasters or posts were set every 30 inches to hold the staves and a 4" x 4" concrete brace post was used at each pilaster. Figure 12 shows this wall on a test silo before filling. This wall is now under trial test so results are not yet available; however, from observations this material looks promising for use as a bunker silo wall and compares favorably in cost with other more or less permanent materials. Figure 13 shows the details for constructing a concrete stave silo wall.

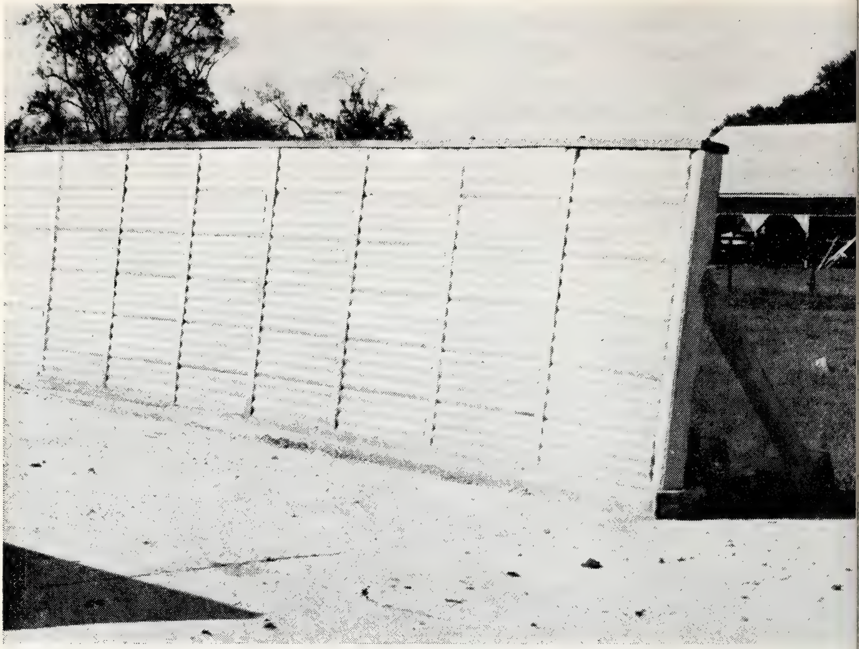
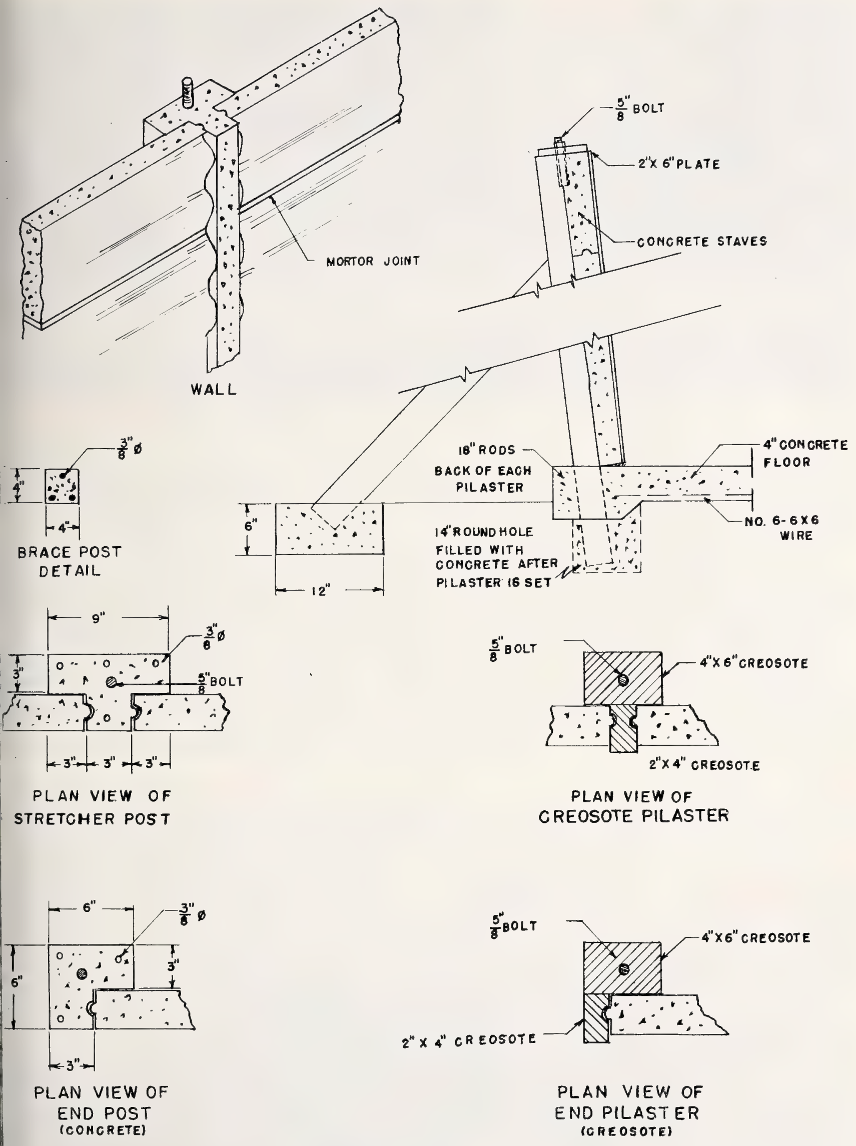


Fig. 12.—Concrete staves used as side wall material.

Self-Feeding Gates

The self-feeding gate is constructed so that the cattle ca
feed themselves from the silo. Figure 2 shows in detail how to cor
struct this self-feeding gate. The horizontal slot type of gate wi
allow more cattle to feed for a given width than will the "V" typ
It also causes less disturbance of the cattle during feeding, sinc
the animal can move over instead of removing her head from th
slot when disturbed by the boss cow. Figure 14 shows an all-welde
metal self-feeding gate mounted on a concrete wall bunker sil
This type of gate is supported on the silo side walls. Some gates hav
been built to rest on a slide at each end of the gate so that the gat
rests on the floor. Either method is satisfactory; however, it i
easier to move the gate when it is supported from a pipe or timbe
and rests on the silo walls.

In feeding from the silo it is necessary to check the silo a
least once every two days and preferably each day. The gate wi
have to be moved forward as the cows eat the silage. This is easil
done by using an iron pipe or bar for a lever to slide the pipe o
timber forward. Some types of silage may be so firmly packed tha
the cows will have difficulty in pulling it from the stack. In thi
case it will be necessary to cut some silage from the stack and pil
it in front of the gate. This is particularly true when calves ar
feeding from the silo.



ig. 13.—Details for constructing a concrete stave wall for a bunker silo.

Filling and Packing

The silo can be filled with either long or chopped forage. Most armers find it requires less labor in handling when the forage is ut and chopped in the field with a forage harvester. Chopped forge is easier to pack and handle at the silo, and forage must be hopped in order for it to be self fed from the bunker silo. The

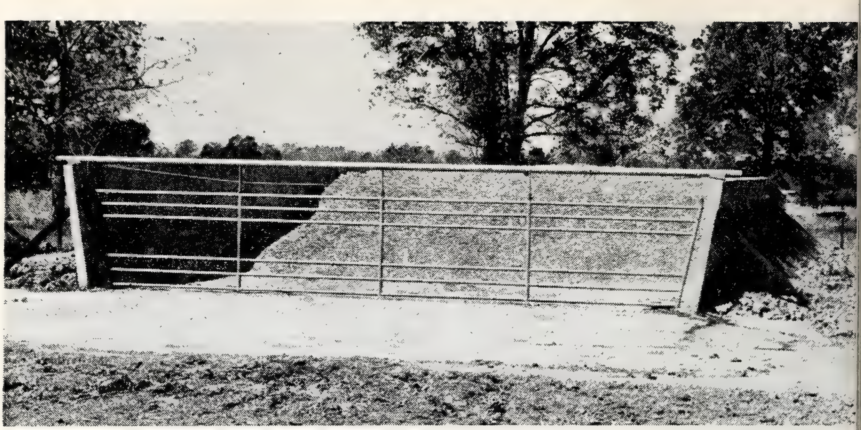


Fig. 14.—Concrete silo and self-feeding gate.

chopped silage is usually hauled to the silo in silage wagons. Thes wagons may have self-unloading features such as a movable en gate, canvas or wire roll bottom, wire sling or dump body.

The regular movable end gate or canvas roll method as used fo unloading silage into a silage blower was found to be slow an inconvenient when used at the bunker silo. It is not necessary t unload the wagon slowly, since a load dumped in one place can easil be spread by the packing tractor. The easiest, simplest and faste method used for unloading the silage wagon was to place a wi mesh sling in the bottom of the wagon and up about three feet o

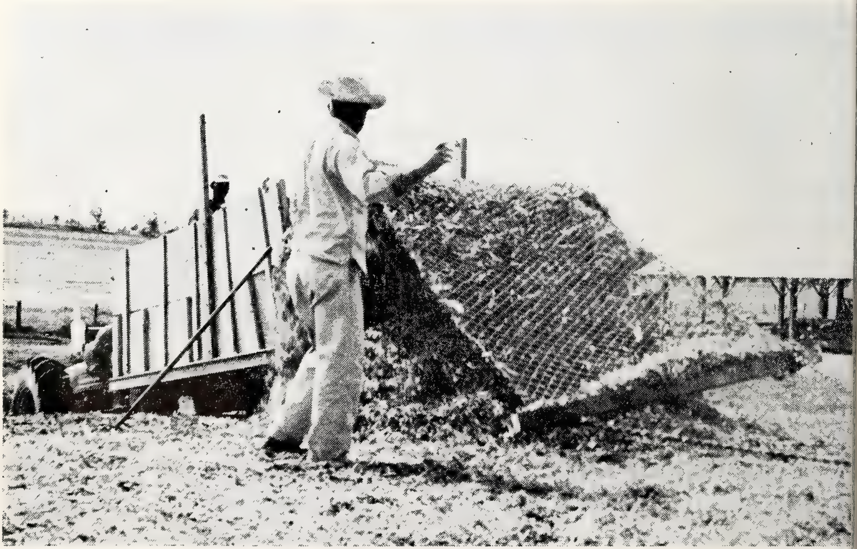


Fig. 15.—Silage wagon having a wire mesh sling being unloaded at the sil

front and back ends. This wire mesh forms the tail gate for the silage wagon body. Two 2" x 6" timbers are bolted at each end of this sling. When the wagon is ready to dump, the end forming the tail gate for the wagon body is let down and a cable extending from the packing tractor is attached to a sling fastened to the front of this wire mesh. As the packing tractor pulls, the whole load of silage is rolled out of the silage wagon. This operation requires only minutes to accomplish. Figure 15 shows a wagon being unloaded in this manner.

To fill the silo, start by dumping the first load at the entrance on the end where the wagons start into the silo and not in the niddle. The reason for this is that the silage itself is used as a amp as the height of the silage increases in the silo, and therefore t must be firmly packed to support the silage wagons. The ramp s then built up to the height of the silo walls. This height is then naintained as filling progresses and the silo is filled, starting at he entrance end. When this method is used the ramp will be well acked and the silage wagons will continuously help pack the silage previously placed in the silo. This ramp is usually fairly gradual in slope on the entrance side but can be much steeper on the exit end. If the silo is to be filled at intervals it is important to keep he gradual slope to facilitate driving through when filling is resumed. Since the thin layer of silage at the lower end of the ramp vill spoil, it is advisable to cut the ramp at a 3-foot depth and add resh forage to the ramp for the next filling.

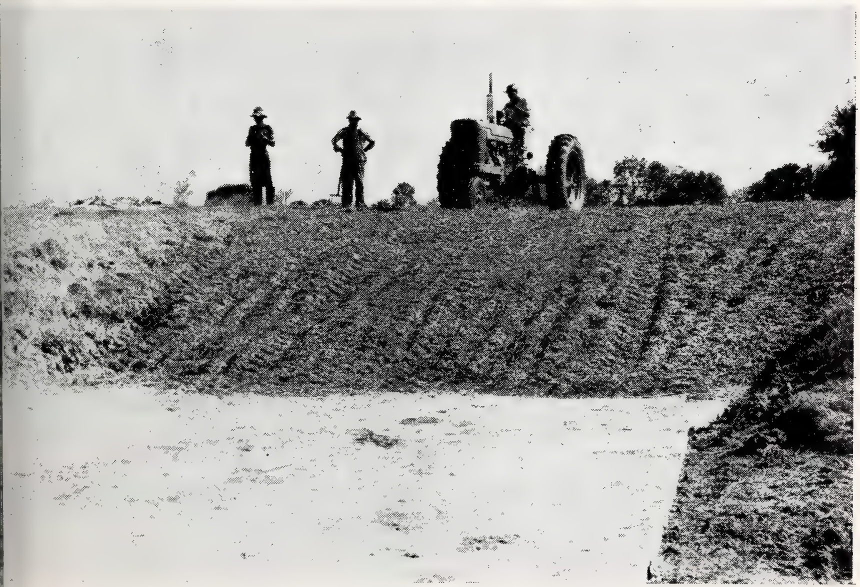


Fig. 16.—Packing an earth bank bunker silo with a farm tractor.

Because of the packing by the hauling wagons or trucks th silage in the middle of the silo will be packed more than that on th sides, so additional effort must be made to make sure that th silage next to the wall is packed equally as well as that at the center The surface of the silage should be kept a little low in the cente during filling, but crowned at least 2 feet on top when filling i completed. This crowning of the silage is shown in Fig. 5. The importance of a good job of packing cannot be overemphasized fo these open bunker silos. Largely, the spoilage found has been due t improper packing. Figure 16 shows a tractor packing silage in a earth bank silo. A tractor should be left on top of the silo to pac for several days after the silo has been filled. If too much settlin occurs next to the sides it is wise to add more silage and pack.

Covering the Silage

Top spoilage can be excessive if the silage is poorly packed an no cover used. A good cover will not make up for poor packing bu it will help to prevent top spoilage and leaching. Some type of suitable cover is recommended. A layer of material such as groun limestone, soil, sawdust, etc. has been used on top of the silage t seal off the surface of the silage from air. Where the silo had bee adequately crowned to shed water these materials have been ver effective under most conditions.

More recently plastic covers have been used very effectivel These covers require less labor to put on and, if well cared for, ca be used for several years. Polyethylene plastic is the most widel used since it is more easily available and lower in cost than viny plastic. The black plastic is more durable than the clear and is mor lasting under outdoor weather conditions. The plastic cover material should be at least a 4 mil thickness, as the lighter weight wi tear too easily. The plastic cover should be carefully weighted dow along the edges to keep it from flopping up and down in th wind as this will allow air to get to the silage and will also resu in tearing of the plastic.

Notes on Making Good Silage

The feeding value of silage after a storage period will depen upon several factors. First, it must be a good quality silage whe put into the silo and must have been cut at the proper stage. I should also be at the proper moisture content, preferably betwee 65 and 70 per cent. Assuming that the quality of ensilage is high can be spoiled by improper handling at the silo.

The process of silage making consists essentially of a restricte respiration of the crop after it has been chopped, which is fo lowed, after the death of the cell, by the action of different group of bacteria. These bacteria do not become active until the air exhausted in the silage. So if the fermentation process, which is th forming of lactic acid, is delayed by trapped air, high temperatures will result and consequently high dry matter loss in the silage.

Proper packing while filling the silo is one of the best ways to exclude air from the silage. However, if the ensilage is too dry it will be spongy and impossible to pack properly and exclude air, resulting in high temperatures and dry matter loss. On the other hand, if the silage is too wet, say 75 to 80 per cent moisture content, excessive pressures from packing occur and lactic acid is not formed. This results in a rancid, putrid smelling silage with less digestible protein than well-cured silage. The addition of a preservative in high moisture silage will help to produce the lactic acid so necessary for making good silage. Preservatives providing carbohydrates such as molasses, ground grain, etc. have been used to form lactic acid. Chemical additives such as sodium meta bisulphate at a usual rate of 10 pounds per ton of green material have become very popular.

Zoerb and others (3) found that more important than additives was the proper sealing of the silo by a good cover. They found that when the silage was properly packed, covering it with a suitable air tight covering produced much better silage and by far lower dry matter loss than when the same silage was treated with additives, such as sodium meta bisulphate, and left uncovered. They also found that a suitable cover over the silo had much more effect toward making good silage than did the moisture content of the ensilage when put into the silo.

Regardless of the type of silo used, careful filling and sealing methods are essential. Careless methods result in excessive spoilage and in the loss of many tons of valuable feed. In addition there is the time and cost of removing this excessive spoilage, plus the time and cost of storing the green forage which it represents. The savings resulting from the use of careful methods will be many times greater than the extra cost involved.

Literature Cited

(1) ESMAY, MERLE L., and BROOKER, D. B. "Lateral Stresses of Silage as Packed in Horizontal Silos." Paper presented at meeting of American Society of Agricultural Engineers, Chicago, Illinois, December 8, 1954.

(2) POOLE, WILEY D. Unpublished data on side wall pressures for bunker silos. La. State University Experiment Station, 1959.

(3) ZOERB, G. C., YOUNG, H. G., DELONG, H. H., and MOE, D. L. "Storage Structures for Grass Silage." South Dakota Agr. Exp. Station, Bulletin No. 477, May 1959.

150 000 2 15 000

[illegible]

Agronomy Department Lysimeters Used in the Study

Bulletin No. 535 May 1960

The Influence of
r Cropping Systems on the Nitrogen
and
Organic Matter Contents
# of Richland Silt Loam

WILLIAM H. WILLIS

Agricultural Experiment Station
Charles W. Upp, Director

Louisiana State University and
Agricultural and Mechanical College

CONTENTS

Pa

Introduction 3

Review of Literature 4

Plan of Experiment 9

Results and Discussion 1

Summary and Conclusions 2

Literature Cited 2

ACKNOWLEDGMENT

The author gratefully acknowledges the participation in this stu of former graduate assistants in the Department of Agronomy: Dr. J E. Sedberry, Agronomist, American Potash Institute, Raleigh, Nor Carolina; Mr. Woody N. Miley, Extension Soil Specialist, Arkansas A ricultural Extension Service, Little Rock, Arkansas; Mr. Esper K. Chan ler, Field Representative, Southeastern Region, National Plant Fo Institute, Knoxville, Tennessee; Mr. Glen D. Johnson, Assistant Prof sor of Agriculture, McNeese State College, Lake Charles, Louisiana; D Laron E. Golden, Assistant Professor of Agronomy, Louisiana Agric tural Experiment Station, Baton Rouge, Louisiana.

The Influence of Four Cropping Systems On the Nitrogen and Organic Matter Contents Of Richland Silt Loam

WILLIAM H. WILLIS
Agronomy Department

INTRODUCTION

In reviewing some of the lysimeter data that had been obtained at thaca and Geneva, New York, at Windsor, Connecticut, at Knoxville, ennessee, and at Riverside, California, Allison (2)[1] pointed out that e nitrogen content of most soils would decrease unless they were kept uncultivated crops. In cultivated soils the decrease would occur re-ardless of how much nitrogen was added as fertilizer. Results at these cations indicated that about 40 to 75 per cent of added and available il nitrogen was recovered by crops. A large portion of that not recov-red in crops could be accounted for in percolation water, but substan-al unaccounted-for losses were frequent. Net gains in nitrogen were few these studies. Evidence indicated substantial losses of nitrogen by latilization.

Considerable conflicting information is available as to the value of oculated winter legumes used as green manure as compared with fer-lizer nitrogen in supplying available nitrogen for the succeeding crops), (8), (10), (14), (15), (17), (18), (19), (23), (31).

Laboratory and greenhouse studies, although they may be contin-ed for several years, cannot be expected to indicate very accurately hat would occur in the field under actual farming conditions. On the her hand, experiments on a field scale do not lend themselves to very curate measurements and one important variable, loss of nitrogen by aching, cannot be measured at all. In order to measure more accurately e influence of cropping systems on the nitrogen and organic matter ntents of the soil and to determine the magnitude of certain gains and sses of nitrogen in the field, and at the same time to provide plots of fficiently small size to permit catching and analyzing soil percolation ater, twelve lysimeters were constructed in 1950 and have been used for is study.

During the course of the study, six years' results of which are reported re, it has been possible to measure all the nitrogen that was added to e soil in rainfall, fertilizer, planted seed, green manure and in clipped rage that was returned to the soil surface. The nitrogen removals that ve been accounted for by actual measurements include that nitrogen harvested crops and that lost by leaching.

---

[1] Numbers in parentheses refer to Literature Cited, Page 25.

REVIEW OF LITERATURE

Andrews (5) , reporting on unpublished data collected over a 12-ye
period at the Mississippi Delta Branch Station, stated: "Even though l
guminous green manure crops produced higher yields of cotton than d
30 pounds of commercial nitrogen, there was little difference in the o
ganic matter content of the soil. These data suggest that the green m
nure crop rotted completely and that the small increases in soil organ
matter were derived from the larger yields of cotton stalks which we
returned to the land."

Results of experiments with winter legumes, continued for ma
years on Mississippi River flood plain soils in Louisiana, were report
by Haddon (14). Increases in yield of one to one and one-half bales
cotton per acre that were obtained by turning under winter legumes
green manure, lasted for three crop seasons provided the practice h
been continued for three years. The results of this test also showed th
the maximum beneficial effect of green manure could be obtained on
by careful attention to such factors as date of planting the legume, see
ing rate, depth of planting and date of turning under.

Patrick, Haddon and Hendrix (20) have reported that the avera
yield per acre of seed cotton for a 25-year period was 1,680 pounds f
lowing common vetch used as green manure as compared with 1,4
pounds using 40 pounds per acre of fertilizer nitrogen on Commer
loam. An average yield of 2,000 pounds per acre of seed cotton was o
tained where hairy vetch was turned under. During the six-year peri
1950-1955, even though 40 pounds per acre of fertilizer nitrogen appli
annually increased the yield of cotton over that obtained from the che
plots, the greater crop residue turned under had little effect in incre
ing or maintaining the soil's supply of organic matter.

Haas, Evans and Miles (13) made a study of the effect of cropping
the carbon and nitrogen content of the soil at 14 locations in the Gre
Plains. The period of cropping ranged from 30 to 43 years and the nitr
gen loss varied from 24 to 60 per cent, with an average loss of 39 per ce
over a 36-year period. Results at three locations in Kansas showed
sharp decline in nitrogen the first 10 to 20 years of cultivation with
tendency to level off in later years. At Sheridan, Wyoming, the decli
was almost linear. Land which had been continuously cropped to sm
grains lost much less nitrogen than that which had been in row cro
Alternate fallow and small grain resulted in more nitrogen loss than c
continuous cropping. The average loss in nitrogen at 11 locations w
24 per cent for continuous small grain, 29 per cent for alternate sm
grain and row crop, and 43 per cent for continuous row crop. Los
from sub-surface soil were much less than from surface soil. The avera
of 12 locations showed a 37 per cent loss from rotations without manu
compared to 25 per cent with manure. Neither rye nor legumes used

reen manure were effective in reducing the loss of nitrogen. Incubation tudies showed a high correlation between nitrogen content of soil and itrate production over a six-week period. In longer incubation periods, igh-nitrogen soils not only produced more nitrate during the first six eeks but maintained a higher rate over long periods. The average loss f soil nitrogen was 39 per cent and the average nitrate-nitrogen-producng ability was 35 per cent. The type of crop growing before sampling had ittle effect on nitrate production. There was little relationship between er cent change in nitrogen and per cent change in yield. In some cases ield changes were greater than nitrogen changes; in other cases the reerse was true. Row crop yields declined more than wheat yields. Beause of lack of response to nitrogen fertilization, it was concluded that oisture was still the limiting factor in crop production in these soils.

Parker, Larson and Bartholomew (19) studied the influence of locaion of plant residues in the soil on the immobilization of nitrogen. In reenhouse studies, corn stalk residue mixed with the soil resulted in a ie-up of nitrogen as compared with the effect of the material when left n the soil surface. No tie-up of nitrogen occurred from the residue on he soil surface. Field experiments showed that low nitrogen residues aplied to the surface resulted in decreased nitrogen uptake and yield of orn. Yields were increased above an unmulched check, however, when ertilizer nitrogen was applied with the low-nitrogen residue.

On a soil in Alabama that was initially very low in nitrogen, Cope, turkie, and Hiltbold (9) found that during an 18-year period more corn nd cotton were produced using annual applications of five tons per acre f manure than with 52 pounds of commercial nitrogen or vetch as green anure. Commercial nitrogen produced higher yields than green manure. hen treatments were suspended on all the plots, there was no residual ield-producing advantage of vetch over commercial nitrogen. The reen manure did not increase soil carbon or soil nitrogen during the 18 ears. Stable manure increased soil carbon 33 per cent and soil nitrogen 2 per cent over the original levels.

Studies by Giddens (11) showed that the organic matter and nitrogen ontent of Georgia soils was rapidly reduced by cultivation. A 57 per cent ss in organic matter occurred with 25 or more years of cultivation. The itrogen content was reduced from 2,695 to 1,659 pounds per acre. Most f the carbon from 20-ton applications of easily decomposable organic atter was lost from a cultivated Cecil soil in 24 months.

Waggoner (31) reported that, based on a three-year average on Prenss loam and Tilden very fine sandy loam soils, vetch alone as a source f nitrogen produced 11 pounds more seed cotton per acre than 90 ounds of nitrogen from ammonium nitrate.

Acharya, Jain and Jha (1) found that in 10 years Berseem fertilized ith phosphorus and grown in a rotation increased the nitrogen content f the soil by 40 per cent as compared with plots where Berseem had not een grown, and increased nitrogen 17 per cent over that where Berseem was grown in a rotation without fertilizer phosphate. Each Berseem cr increased soil nitrogen by about 78 pounds per acre. Since the roots a nodules of the Berseem plants accounted for only about 11 pounds of trogen per acre, they concluded that the bulk of the nitrogen addition the soil resulted from nitrogen excretions while the Berseem crop w growing.

Fribourg and Bartholomew (10) determined the relative availabilit of nitrogen in alfalfa tops, red clover tops, soybean straw, oat hulls, a ammonium nitrate at different rates of application. Using corn as the dicator crop the first season after soil treatments, they found that alfa was more efficient in increasing yield than the red clover green manu Soybean straw had little or no effect and oat hulls tied up soil nitrog and decreased yield. The alfalfa green manure was about 34 per cent efficient as ammonium nitrate on the basis of pounds per acre of nit gen applied. In the second growing season, using oats as the idicator cr nitrogen availability was not more than 7.5 per cent of that origina contained in alfalfa, and 3.5 per cent of that contained in red clov Nitrogen availability from soybean straw was about 2 per cent. No nit gen was available from oat hulls.

Stojanovic and Broadbent (27) incubated two Gray-Brown Podzo soils of New York under controlled temperature, moisture and aerati The soils were treated with wheat straw or corn leaves and inorganic trogen. Added ammonia was immobilized when corn leaves were add with ammonia nitrogen. Reduction of added nitrate nitrogen was ne gible in the presence of corn leaves. They concluded that a substant amount of nitrogen was turned under in the presence of available ene and that immobilization of nitrogen was significant even in the deco position of a high nitrogen-containing material such as corn leaves.

Allos and Bartholomew (4) applied quantities of tagged N^{15} varyi from 0 to 432 milligrams per pot for seven legumes grown in explod vermiculite with a nutrient solution. They found that the magnitude nitrogen fixation by the legumes was proportional to the total grow and nitrogen uptake. Nitrogen fixation decreased and fertilizer abso tion increased with an increase in the quantity of nitrogen that was ava able.

Chapman, Liebig and Rayner (8) reported that unaccounted-for losses of nitrogen, thought to be due to gaseous volatilization, amoun to more than 60 pounds per acre annually with a mustard cover c when 200 pounds of nitrogen per acre were added as a fertilizer to soil. Similar losses occurred as a result of cereal straw applications s plemented with 200 pounds of nitrogen. Net gains of nitrogen when gume cover crops were grown without fertilization amounted to as mu as 150 pounds per acre annually. Net gains of nitrogen due to non-sy biotic fixation amounted to 48 pounds per acre per year when dry cer straw was applied without fertilization. The average loss of nitrog through leaching varied from 4 to 88 pounds per acre annually. T

naximum losses occurred when no winter cover crop was grown and also
vhen heavy applications of nitrogen were used.

Broadbent and Chapman (6) stated that there was no way of measur-
ng the absolute quantity of nitrogen added to the soil by the fixation of
tmospheric nitrogen, nor of evaluating losses which are attributed to
olatilization. Two nitrogen-balance figures were given, one representing
he difference between measured additions and removals and the other
ased on soil analysis at the outset and after 15 years. The discrepancy
etween these two figures represented the net effect of fixation on one
and and volatilization losses on the other. The authors mentioned that
statistical estimate of sampling error indicated that the nitrogen con-
ent between the initial and final sampling periods might vary as much
s 320 pounds per acre without being significant at the 5 per cent level.

Broadbent and Stojanovic (7), using the sensitive tracer technique with
N^{15}, have found appreciable losses of nitrogen to occur when nitrate is
dded to the soil. Although the losses were greater at low oxygen con-
entrations, they were not restricted to conditions of poor aeration. The
ninimum loss obtained was 16 per cent of that added, and occurred at
9 per cent oxygen. An 81 per cent loss occurred in another soil with 2
er cent corn leaves added and at 0.1 per cent oxygen. There was little
vidence of nitrogen loss from ammonium salts added to the soil.

Pinck, Allison and Sherman (21) found that when plant materials
aving carbon-nitrogen ratios of 18 to 102 were added to Cecil clay loam
oil in the laboratory, no significant loss of gaseous nitrogen occurred.
Vhere the ratios of the added material were as narrow as 3 to 15, marked
itrogen losses occurred and these losses increased as the nitrogen con-
ent increased. Thus the importance of carbon in holding nitrogen in
he soil was demonstrated. The composition of added materials was
nore important than the carbon-nitrogen ratios in determining the per-
entage of carbon that would be left in the soil after an extended period
f time. The carbon of succulent green manure crops was retained in
he soil to almost as great a degree as was that from mature plant ma-
erials. The main effect of nitrogen added to nitrogen-deficient crop resi-
ues was to increase the rate of humus formation. With nitrogen-deficient
naterials added, the organic matter remained only partly decomposed.
They concluded that supplemental additions of nitrogen to nitrogen-
eficient materials were not necessary to hold carbon in the soil during
he process of humus formation. Calcium carbonate added to Cecil soil
ncreased the rate of decomposition and amount of carbon lost. No sig-
ificant amounts of nitrogen were fixed in either limed or unlimed Ce-
il soil. The initial pH of the soil was 4.9.

Wilson (35) found that under artificial conditions many strains of
Rhizobium would reduce nitrate to nitrite and that the nitrite in an acid
nedium would react with many compounds and liberate gaseous nitro-
en. He expressed doubt that such a reaction occurred in actively func-
oning nodules.

Losses by volatilization of added fertilizer nitrogen may be very larg even from moderately acid soils. This has been recently demonstrated laboratory studies by Wagner and Smith (32) in Missouri. In their expe ments, measured losses ranged up to 85 per cent of the added nitrogen.

Goring and Clark (12) found a highly-significant difference in tot numbers of bacteria in cropped and fallow soils; however, there were significant differences in numbers of *Nitrosomonas* and *Nitrobacter*. was concluded that less mineral nitrogen accumulated in cropped so than in fallow soils, even though an accounting was made of the nitrog removed by cropping. The extent of the nitrogen deficit encounter was correlated with total weight of roots, with nitrogen content of t crops grown, and with the increase in numbers of microorganisms th occurred with plant growth. These workers believed that unaccounte for nitrogen in cropped soils was immobilized rather than lost to the a

Karraker (17) has reported the influence of various cropping pr tices on the nitrogen content of soils in plots in Kentucky. In soil us for rotation experiments, the nitrogen content decreased when soybea and cowpeas were grown for hay but was maintained or increased wh red clover was grown for hay. Alfalfa, sweet clover and lespedeza, wh grown for hay, barely maintained the nitrogen content. In three outlyi experimental fields, the nitrogen content of the soil averaged 28 per ce higher in manure-limestone-phosphate plots than in nontreated plo and 17 per cent higher in the manure-limestone-phosphate plots than those receiving only manure.

Karraker, Bortner and Fergus (18) found, in lysimeter studies in Ke tucky, that less nitrogen was added to the soil by fixation when a legu was grown with a non-legume than when the legume was grown alo This was due largely to the fact that the non-legume reduced the grow of the legume. During an eleven-year period, 2,452 and 2,265 pounds nitrogen per acre were fixed where alfalfa and korean lespedeza we grown alone, respectively. The soil gained 33 pounds of nitrogen p acre where bluegrass was grown. This gain was thought to be due to no symbiotic nitrogen fixation. Uncropped soil lost 9.5 per cent of its nit gen by leaching during eleven years. This loss occurred mainly from t surface soil and from January through April. Leaching losses were o slight where grass, rye cover crop, alfalfa or good covers of white or r clovers were grown.

Five-year lysimeter studies conducted by Jacobson, Swanson and Smi (15) showed that 95 per cent of the nitrogen leached from the soil w lost during the first six months after fertilizer application. Phosphate a carbonate anions exerted a more beneficial effect on nitrification of ur than did sulfates and chlorides. Cations produced no marked differen on nitrification. Phosphorus appeared to be the limiting element f maximum nitrification of urea.

At College Station, Texas, Reynolds and Norris (23) found no sign cant differences in yield of corn in 1950 after winter legumes had be urned under in the spring of 1949 and cotton was grown on the land in 949. Sixty pounds of nitrogen applied to the corn did give a significant ncrease in yield.

Allison and Sterling (3) found nitrate formation from soil organic atter to be directly correlated with the total soil nitrogen in a sandy oil. Nitrates were negatively correlated with percentage of nitrogen lost uring 33 years of cropping. They concluded also that the thoroughly umified soil organic matter in a given soil type under like climatic conitions was fairly uniform in quality regardless of past agronomic pracices, and that the total-nitrogen content was a rough index of the nitrateurnishing power of variously treated soils.

Singh, Gangadhar and Shrikhande (25), using a nitrogen-free solution ontaining one per cent mannitol in pot cultures, found that the optium concentration of phosphorus for nitrogen fixation by *Azotobacter* aried not only with different forms of phosphorus but also with the age f the culture of the bacteria. Vyas (29) studied the influence of four orms of phosphorus on nitrogen fixation by peas. All four forms of hosphorus tested were found to increase nitrogen fixation. Two rock hosphate forms were inferior to superphosphate and bone meal. Vyas nd Desia (30) found that the addition of superphosphate to the soil inreased the number and nitrogen content of nodules on the pea plant and lso increased the yield of nitrogen content of the plants.

The Winogradsky spontaneous culture test for *Azotobacter* that was nproved by Winogradsky and Ziemiecka (36) has been used and modied by many investigators, including Sackett and Stewart (24), Wilson 33), (34) and Van Eseltine (28). This method has been used for the determination of occurrence and distribution of *Azotobacter* in soils.

Jenny (16) pointed out many years ago the influence of rainfall and emperature on the nitrogen and organic matter content of soils in the nited States. He observed that from the Gulf Coast to the North Cenal states, there was an increase of two to three times in soil organic mater and nitrogen with each 18° F. decrease in temperature.

It is apparent from the review of some of the literature that the efects of different cropping systems, fertilizer nitrogen and leguminous reen manure on the nitrogen and organic matter contents of soils are uite variable. Such factors as kind of crops grown, the soil used in the xperiment, climatic conditions, amount of fertilizer nitrogen used, nonmbiotic nitrogen-fixing microorganisms, nitrogen losses by volatilizaon, and especially the quantity and quality of leguminous green maure turned into the soil, influence the nitrogen and organic matter connts of the soil.

PLAN OF THE EXPERIMENT

The twelve lysimeters were constructed in August, 1950. Each lysieter was 43 inches square, or appriximately .0003 acre in area. They ere 42 inches deep, built of concrete and arranged in two rows of six each, on either side of a concrete tunnel. The tunnel was approximatel six feet wide and eight feet deep, provided with a roof and an outl from the bottom of each lysimeter entering the tunnel through the wal The percolation water from each lysimeter was caught in a 20-gallo aluminum stock pot (Figure 1).

The inside of each lysimeter was coated with asphalt and a black iro perforated plate was placed over the outlet. A thin layer of fine grav was placed in the bottom. Richland silt loam, a Mississippi terrace soi was then placed in each lysimeter in as nearly its natural condition wit respect to thickness of horizons and degree of compaction as practicabl The thickness of the A horizon was 6 to 7 inches. The B horizon extende to a depth of 28 inches. Since the soil was very dry when placed in th lysimeters, it was wetted slightly to help obtain the normal degree compaction and fill large voids with the soil. Care was taken not to pu dle the soil.

The A horizon of the soil placed in the lysimeters had an exchang capacity of 10.0 m.e. and base saturation of 51 per cent. The pH was 5. The phosphorus soluble in .05 N. HCl was 8 p.p.m. The exchangeab potassium content, as extracted with .05 normal nitric acid, was 60 p.p.r The soil contained 0.063 per cent total nitrogen and 1.16 per cent o ganic matter.

In September, 1950, the soil was limed with two tons per acre of fine ground dolomitic limestone (55% $CaCO_3$ and 43% $MgCO_3$) to raise th pH to 6.5. Lime was added as needed at two- to three-year intervals du ing the course of the experiment to maintain the pH at or near 6.5. Fe tilizer was added to the soil in all lysimeters at the rate of 400 pounds 4-12-12 per acre at the beginning of the experiment.

The following crops and crop combinations were used in triplicat

1. White clover and Dallisgrass grown continuously and clipped pe odically, with half the forage returned to the surface of the plots.
2. Dallisgrass grown continuously and clipped periodically, with ha the forage returned to the surface of the plots.
3. Cotton (Sudangrass in 1953), following an inoculated winter l gume used as green manure.
4. Cotton (Sudangrass in 1953), fertilized with 60 or 72 pounds nitrogen per acre, one-half the nitrogen applied at planting and the r mainder applied as a side dressing when the plants were 8 to 10 inch high.

All the plots received 600 pounds of 0-12-12 fertilizer per acre ea spring. On the plots with continuous cover the fertilizer was spread the surface and chopped into the soil without destroying the vegetati cover. On the plots where cotton was grown the fertilizer was mixed wi the soil in the row two to three inches below seed level. On the plots which Dallisgrass alone was grown, it was necessary to apply fertilizer n trogen at the rate of 60 pounds per acre in 1953, and 72 pounds per ac in 1954 and 1955 in order to produce any forage. This nitrogen fertiliz

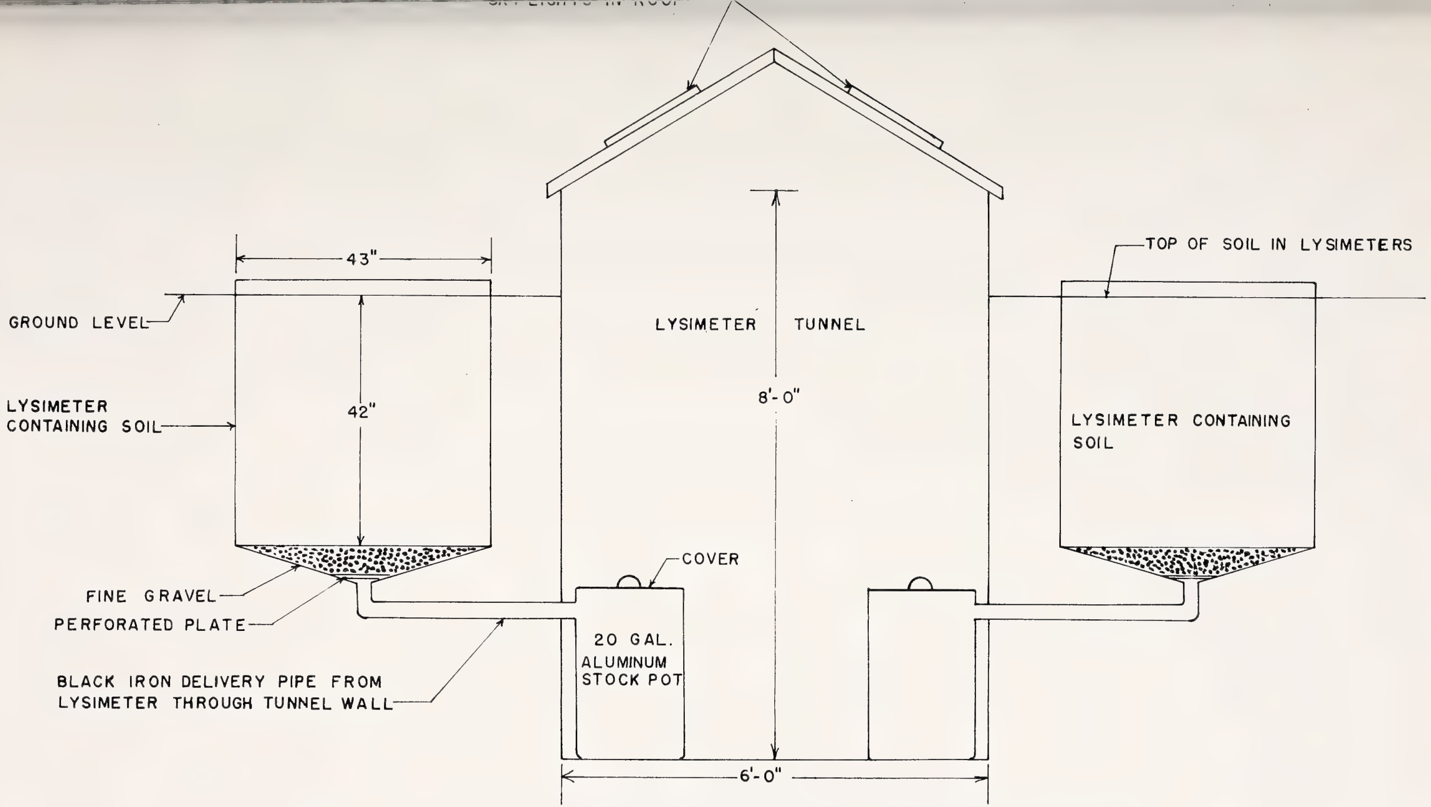

TOP OF SOIL IN LYSIMETERS
43"
GROUND LEVEL
42"
LYSIMETER TUNNEL
8'-0"
LYSIMETER CONTAINING SOIL
LYSIMETER CONTAINING SOIL
COVER
FINE GRAVEL
PERFORATED PLATE
20 GAL. ALUMINUM STOCK POT
BLACK IRON DELIVERY PIPE FROM LYSIMETER THROUGH TUNNEL WALL
6'-0"

Figure 1.—Cross-sectional Diagram of Agronomy Department Lysimeters.

was applied to the surface as a top dressing. The fertilizer elements we
in the form of ammonium nitrate, monocalcium phosphate and pota
sium chloride. All were reagent-grade chemicals. No nitrogen was applie
to the clover-grass plots or to the cotton plots with green manure aft
the initial application of 16 pounds per acre that was made to all plo
in the fall of 1950.

The forage that was produced on the clover and grass plots and
the grass plots was clipped at intervals, weighed, and one-half the fora
was returned to the soil surface. The other half was used for determin
tions of water and nitrogen content. The yield on a dry weight basis ar
the amount of nitrogen removed in the harvested forage was determine
The forage was clipped three to seven times each year, depending upo
its rate of growth.

On the plots where cotton was grown following leguminous gree
manure, the legume, hairy vetch, *Vicia villosa,* was seeded at the rate
30 pounds per acre about October 10 each year. The seed were inoculate
with a fresh commercial culture of inoculant. The green manure w
clipped about March 20, weighed, and sampled for determinations
water and nitrogen content. The green manure was then turned ar
mixed with the soil to a depth of six inches. D. & P.L. 15 cotton w
planted about April 20 in a single row across the center of the plots. S
hundred pounds of 0-12-12 fertilizer per acre was placed in the row ar
mixed with the soil to two to three inches below seed level. The cotto
plants were thinned to six per plot when they were about five inch
high. Insects were controlled by frequent dusting with a commercial mi
ture of 3 per cent BHC, 5 per cent D.D.T., and 40 per cent sulfur,
toxaphene, or calcium arsenate and by spraying with malathion solutio
10 ml. per gallon of water. When the cotton was mature it was picke
air dried and weighed. The moisture and nitrogen content of the se
were determined and the amount of nitrogen removed from the plo
was calculated. The cotton stalks were then chopped into small piec
and turned into the soil. Sudangrass was substituted for cotton in 19
because a more uniform nutrient status in the soil in each of the cul
vated plots was desired and a broadcast crop of Sudangrass would produ
this result better than cotton. The Sudangrass crop was harvested at m
turity. The yield on the dry weight basis and the amount of nitrog
removed in the crop was determined. The stubble left on the plots w
turned into the soil.

The three remaining plots were cropped to cotton fertilized ea
spring with ammonium nitrate. In 1952 and 1953 the rate was 60 poun
of nitrogen per acre annually. The rate was then increased to 72 poun
per acre annually because a nitrogen deficiency was quite apparent
the plants on these plots as compared with the plants grown on t
green-manure plots. One-half the nitrogen was applied below the se
at planting and the remainder was added as a side dressing when t
plants were about eight inches high.

In addition to the measurements of nitrogen applied as fertilizer and in green-manure and nitrogen removed from the plots in harvested crops, the percolation water from each lysimeter was caught, measured and analyzed for ammonium and nitrate nitrogen. These leaching losses were then converted to the pounds per acre basis. All rainwater was also caught, measured and analyzed for ammonium and nitrate nitrogen to determine the amounts of nitrogen brought down to the soil by rainfall. The measurements of percolation and rainfall were made for each rain or storm period during the six-year period. No runoff from the soil surface was allowed. The amount of nitrogen added to the soil in planted cotton seed and vetch seed was calculated, but since less than two pounds per acre were added in cotton seed and less than seven pounds in vetch seed during six years, the addition was not included in any of the tables.

Although the study was begun in October, 1950, only the results for the period October 1, 1951, through September 30, 1957, are reported here; the first year's results were omitted since that was the period of greatest settling of the soil in the lysimeters.

The data reported as pounds per acre were calculated on the basis of two million pounds of soil, dry weight. The "experiment year" in this study began on October 1 and ended September 30. About October 1 of each year samples of the soil in each lysimeter were taken from the ½-inch to the 6-inch depth. Samples were taken from five locations in each lysimeter and composited. An observation made consistently during the course of this study indicated that the greatest single source of error was in the sampling of the soil in the plots. Thus, if five individual soil samples were taken from different locations in a plot, composited, and analyzed for total nitrogen, the results might vary as much as 10 per cent from those on another composite sample made up of individual samples taken from five other locations. This source of variation has been discussed at length by Chapman, Liebig and Rayner (8).

The soil samples were air dried, crushed, passed through a 20-mesh screen, and used for total nitrogen and organic carbon determinations. Nitrogen in the soil and in plant materials was determined by the modified Kjeldahl method. Carbon was determined by the dry combustion method as described by Piper (22). Per cent organic matter was calculated by multiplying per cent carbon by 1.724.

The phenoldisulfonic acid method was used to determine nitrate-nitrogen in rain and peroclation water and in soil. The optical density of the unknown samples was compared with that of standard nitrate solutions in an electro-photometer using water as a blank. Ammonium nitrogen in the rain and percolation water was determined by Nesslerization and comparison of the color intensity with that of standard ammonia solutions.

To determine the occurrence of *Azotobacter* in the soil under the four cropping systems, the relative numbers of the organisms were determined in the soil samples taken each October. The occurrence of *Azotobacter*

was determined with the use of a modification of the Winogradsky spo
taneous culture test by preparing soil plaques in duplicate and usi
sterilized silt loam soil in Petri dish halves 5.7 cm. in diameter. The s
was sterilized in an air-dry condition in an autoclave. Sufficient 3 p
cent starch solution was added to the sterilized soil to form a soil past
This was then smoothed on the surface with a sterile spatula wetted wi
the starch solution. A one-gram sample of the air-dried soil from the ly
meters was then carefully spread on the surface of the sterile soil plaq
and smoothed with a sterile spatula. The plaques were incubated in
moist chamber at 30° C. for 72 hours. The only colonies of microorga
isms that appeared on these plaques in 72 hours, as revealed by micr
scope examinations of numerous slides prepared from colonies and inte
colony surfaces, were those of *Azotobacter*. The *Azotobacter* colonies th
developed using starch as the energy source were easily visible. Th
were dark rust-brown in color, flat, dry and 1 to 1.5 mm. in diameter.
sterile 2 per cent mannitol solution was also used as an energy sour
on duplicate soil samples. Mannitol was not as satisfactory as starch
though the number of *Azotobacter* colonies developing on the mannit
plaques was about the same as with starch. The mannitol promoted t
rapid growth of subsurface organisms that were gas-producers. This g
disrupted the smooth surface of the plaques, which made colony iden
fication more difficult. Another disadvantage of the mannitol plaqu
arose from the fact that the *Azotobacter* colonies were clear, raised, se
rated, viscous, spread quickly to about 5 mm. diameter, and frequent
coalesced with nearby colonies. These tests for relative numbers of *Azot*
bacter were repeated on the samples of air-dried soil that had been stor
in sealed jars for periods of up to six years. The results were similar
those obtained on the fresh, air-dried samples.

RESULTS AND DISCUSSION

The amount of rain water that percolated through the 42-inch c
umn of soil, the nitrate and ammonium-nitrogen content of the perco
tion water under the four-cropping systems, and the rainfall and nitr
gen content of the rain water for each year of the experiment, are show
in Table 1. The rainfall varied from 44.4 to 67.6 inches per year a
averaged 54.6 inches.

The mean annual water loss by percolation was about one-half t
rainfall and was not materially influenced by treatment over the si
year period. The largest annual loss of water by percolation occurr
during the fourth year and was the result of a few heavy rains that f
when the soil had been saturated only two or three days before. Duri
this period, percolation varied from 76.9 per cent to 85.4 per cent of t
rainfall.

Available nitrogen lost by leaching was largely in the nitrate for
Only in one year (the sixth) and on two cropping systems (continuo
grass, and clover and grass) did the loss of the ammonium form exceed t

and nitrogen content of rain water, six-year period

	Water and nitrogen losses							
	Year						Total, six years	Mean annual
	1st	2nd	3rd	4th	5th	6th		
Cropping system								
Clover and grass, ½ clippings returned								
Water lost, inches	8.4	28.3	28.2	45.5	19.8	20.9	151.1	25.2
Per cent of rainfall	16.2	41.9	59.0	77.2	44.6	36.9	46.2	46.2
NO_3-N., Lbs./A.	4.8	13.2	23.9	18.8	2.1	3.2	66.0	11.0
NH_3-N., Lbs/.A.	0.1	0.6	3.7	0.8	0.3	4.9	10.4	1.7
Total N., Lbs./A.	4.9	13.8	27.6	19.6	2.4	8.1	76.4	12.7
Grass, ½ clippings returned								
Water lost, inches	20.3	32.6	26.5	49.2	27.4	26.2	182.2	30.3
Per cent of rainfall	39.0	48.2	55.4	83.5	61.7	46.2	55.6	55.5
NO_3-N., Lbs./A.	2.3	4.9	7.0	11.9	1.4	1.4	28.9	4.8
NH_3-N.., Lbs./A.	2.1	0.6	3.8	0.6	0.6	5.3	13.0	2.2
Total N., Lbs./A.	4.4	5.5	10.8	12.5	2.0	6.7	41.9	7.0
Cotton after legume green manure								
Water lost, inches	13.9	27.8	21.6	50.3	19.9	15.4	148.9	24.8
Per cent of rainfall	26.7	41.1	45.2	85.4	44.8	27.2	45.5	45.4
NO_3-N., Lbs./A.	12.2	36.1	27.2	94.7	7.8	21.1	199.1	33.2
NH_3-N., Lbs./A.	0.9	0.3	2.2	0.7	0.4	2.4	6.9	1.1
Total N., Lbs./A.	13.1	36.4	29.4	95.4	8.2	23.5	206.0	34.3
Cotton with fertilizer nitrogen								
Water lost, inches	17.1	27.1	27.4	45.3	20.4	12.5	149.8	25.0
Per cent of rainfall	32.9	40.1	57.3	76.9	45.9	23.0	45.8	45.8
NO_3-N., Lbs./A.	7.9	32.3	46.4	32.1	8.9	6.6	134.2	22.4
NH_3-N., Lbs./A.	0.9	0.5	3.7	0.4	0.0	2.1	7.6	1.2
Total N., Lbs./A.	8.8	32.8	50.1	32.5	8.9	8.7	141.8	23.6
Rainfall, inches	52.0	67.6	47.8	58.9	44.4	56.7	327.4	54.6
Nitrogen in rainwater								
NO_3-N., Lbs./A.	3.2	2.0	2.6	8.8	4.0	4.7	25.3	4.3
NH_3-N., Lbs./A.	6.7	2.9	10.1	4.5	0.0	6.6	30.8	5.1
Total N., Lbs./A.	9.9	4.9	12.7	13.3	4.0	11.3	56.1	9.4

L.S.D. for mean annual loss of nitrogen = 15.5 lbs. per acre at 5% level of probability.
L.S.D. for mean annual loss of nitrogen = 21.4 lbs. per acre at 1% level of probability.

loss of the nitrate form. Nitrogen losses by leaching were large enough to be of importance on both the cropping systems in which cotton was grown. The greater loss occurred from the soil where cotton was grown following leguminous green manure. This soil contained more nitrogen. The losses from the plots where cotton followed leguminous green manure varied from 8.2 to 95.4 pounds of nitrogen per acre per year and averaged 34.3 pounds for the six-year period. Nitrogen losses from the soil where cotton was grown with fertilizer nitrogen varied from 8.7 to 50.1 pounds per acre per year and averaged 23.6 pounds for the six-year period. The continuous-cover plots lost an average of 7.0 and 12.7 pounds of nitrogen per acre per year from the clover and grass and grass plots, respectively. Although the average losses for the six-year period from these latter two cropping systems were not large, the losses during certain years were of significance, especially from the clover and grass plots. The two largest leaching losses from grass alone occurred during the latter two of the three years when it was necessary to add fertilizer nitrogen to maintain growth of the grass. No runoff was allowed from any of the plots.

The yield and nitrogen content of the forage removed from the continuous-cover plots are shown in Table 2. It may be noted that the mean annual yield of clover and grass was almost three times that of grass alone. The nitrogen contained in the clover and grass forage was almost twice that in the grass on a percentage basis and in terms of pounds of nitrogen per acre was over five times that in the grass. Since only one-half of the forage was removed in each case, an equivalent amount was returned to the soil surface. No nitrogen fertilizer was added to the clover and grass plots after planting, whereas 60 pounds of fertilizer nitrogen per acre was added to the grass plots the second year, and 72

TABLE 2.—Yield and nitrogen content of forage removed from continuous-cover plots
six-year period

	Clover and grass, ½ clippings returned			Grass, ½ clippings returned		
Year	Yield, dry weight, Lbs./A.	Nitrogen content, Per cent	Nitrogen removed, Lbs./A.	Yield, dry weight, Lbs./A.	Nitrogen content, Per cent	Nitrogen removed, Lbs./A.
1st	5,762	1.92	163	751	0.80	6
2nd	4,268	2.11	90	1,897	1.21	23
3rd	2,667	2.89	77	1,211	1.65	20
4th	5,397	1.98	107	2,303	1.17	27
5th	6,684	2.06	138	1,612	1.36	22
6th	3,557	2.44	87	2,487	1.12	28
Total—6 years	28,335	...	667	10,261	...	126
Mean annual	4,722	2.23	111	1,710	1.23	21

L.S.D. for yield = 1439 lbs. per acre at 5% level of probability.
L.S.D. for yield = 2047 lbs. per acre at 1% level of probability.

pounds per acre were added in the third and again in the fourth year to maintain growth of the grass.

In spite of the removal of an average of 111 pounds of nitrogen per acre per year in the harvested clover and grass, the soil in these plots showed a substantial net annual gain in nitrogen. The gain in the nitrogen content of this soil was undoubtedly due largely to symbiotic nitrogen fixation by the inoculated white clover. Some nitrogen was probably added also by fixation by *Azotobacter* which appeared in the soil in these plots the fourth year of the experiment. An average of only 21 pounds of nitrogen per acre was removed in forage where grass alone was grown.

In order that the effect of legume green manure in supplying available nitrogen for the succeeding crop might be determined, cotton was grown following the turning under of an inoculated winter legume and also with the use of 60 or 72 pounds per acre of fertilizer nitrogen as ammonium nitrate without green manure. The yield and pounds per acre of nitrogen turned under in the green manure each spring are shown in Table 3. There was an average of 5,108 pounds per acre, dry weight, of green manure containing 184 pounds of nitrogen turned under each spring. The amount of nitrogen turned into the soil in green manure varied from 102 to 277 pounds per acre per year and was largely dependent upon quantity of legume material produced.

TABLE 3.—Yield and nitrogen content of leguminous green manure and the nitrogen turned under before cotton was planted

Year	Yield, dry wt., Lbs. per A.	Nitrogen content, Per cent	Nitrogen turned under, Lbs. per A.
1	2,859	3.57	102
2	5,840	3.89	227
3	7,613	3.64	277
4	6,261	3.05	191
5	5,622	3.59	202
6	2,452	4.24	104
Total, six years	30,647	...	1,103
Mean annual	5,108	3.66	184

The yield of cotton following legume green manure as compared with that obtained with fertilizer nitrogen is shown in Table 4. The mean annual acre yield of seed cotton for the five years cotton was grown was 2,748 pounds from the use of leguminous green manure as compared with 2,262 pounds using fertilizer nitrogen. The average annual increase from green manure was 486 pounds. The difference of 486 pounds is significant at the one per cent level of probability in spite of the slightly higher yield produced with fertilizer nitrogen the first year of the experiment. The comparative mean annual yields of cotton following leguminous green manure and those obtained with an average of 70 pounds of available fertilizer nitrogen indicate that an average of 85 pounds, or 49 per cent, of the organic nitrogen in the green manure became available to the succeeding cotton crop. The nitrogen supplied by the legume green manure not only produced more cotton than the fertilizer nitrogen but also contributed to a net annual increase of 106 pounds of nitrogen per acre in the soil.

TABLE 4.—Yield of seed cotton following leguminous green manure and with fertilizer nitrogen

Year	N. turned under in green manure	Yield of seed cotton after legume green manure	Nitrogen applied in fertilizer	Yield of seed cotton with fertilizer nitrogen
	Lbs. per A.		Lbs. per A.	
1	102	3,474	60	3,591
2	227	. . . .[1]	60	. . .[1]
3	277	2.217	72	1,950
4	191	3,299	72	1,924
5	202	2,447	72	2,080
6	104	2,305	72	1,763
Total, five years	876	13,742	348	11,308
Mean annual	175	2,748	70	2,262

L.S.D. for mean annual yield of seed cotton = 430 lbs. per acre at 1% level of probability.

[1] Sudangrass, planted in 2nd year, yielded 10,276 lbs. per acre, dry weight, following green manure and 7,319 lbs. per acre with fertilizer nitrogen.

The changes that occurred in the nitrogen and organic matter contents of the soil under the four cropping systems during the six years are shown in Table 5. It should be noted that the nitrogen content of the soil was not the same in all cases at the beginning of the experimental period reported here. As explained previously, the soil was placed in the lysimeters 13 months before the beginning of the six-year period reported in this paper. When the soil was first placed in the lysimeters, the 0- to 6-inch layer contained 0.065 per cent nitrogen in all cases.

The largest increase in soil nitrogen during the six-year period occurred where legume green manure preceded cotton; the smallest increase occurred where cotton was grown with fertilizer nitrogen. The increase in the nitrogen content of the soil did not occur at a regular rate under any of the cropping systems. In all treatments there were occasional slight decreases from one year to another, which indicated that if significant net changes in the nitrogen content of a soil in a field are to be measured, the experiment must be conducted and the changes followed over a period of years. The difference between the mean annual nitrogen content of the soil where a legume was grown and that of the soil where no legume was included in the cropping system, was highly significant.

TABLE 5.—Changes in nitrogen and organic matter contents in Richland silt loam soil, ½- to 6-inch depth, under four cropping systems during a six-year period

	Clover and grass, ½ clippings returned		Grass, ½ clippings returned		Cotton after legume green manure		Cotton with fertilizer nitrogen	
	Lbs. per A.		Lbs. per A.		Lbs. per A.		Lbs. per A.	
Year	N.	Org. Mat.	N.	Org. Mat.	N.	Org. Mat.	N.	Org. Mat.
At beginning	1,527	20,700	1,360	19,100	1,527	20,000	1,487	20,000
1st	1,667	23,000	1,367	18,800	1,507	19,800	1,427	19,800
2nd	1,867	27,700	1,580	24,600	1,787	26,700	1,587	23,700
3rd	1,667	21,000	1,540	20,500	1,933	25,700	1,533	21,000
4th	1,933	24,000	1,747	22,400	2,020	27,200	1,560	21,600
5th	2,113	24,400	1,807	23,900	2,280	27,000	1,693	20,200
6th	2,073	29,300	1,833	24,700	2,160	28,700	1,613	21,200
Mean	1,835	24,300	1,605	22,000	1,888	25,000	1,557	21,100

L.S.D. for nitrogen = 117 lbs. per A. at 5% level of probability.
L.S.D. for nitrogen = 161 lbs. per A. at 1% level of probability.
L.S.D. for organic matter = 1,904 lbs. per A. at 5% level of probability.
L.S.D. for organic matter = 2,606 lbs. per A. at 1% level of probability.

Clover and grass and leguminous green manure resulted in significant increases in the organic matter as well as nitrogen content of the soil. Continuous grass increased the organic matter in the soil to a lesser degree. The organic matter content of the soil was not increased significantly where cotton was grown with fertilizer nitrogen.

In order to determine whether the accumulations of nitrogen in the soil under the four cropping systems were related to the occurrence of the nonsymbiotic nitrogen-fixing bacteria of the genus *Azotobacter,* the relative numbers of these organisms in the soil were determined in the soil samples taken each year during the experiment. As shown in Table 6, *Azotobacter* were not present in the soil at the beginning nor at the end of the first year. They began to appear in the soils that were cropped to cotton during the second year and in those with continuous cover during the fourth year. After six years the largest *Azotobacter* population had developed in the soil with the lowest nitrogen and organic matter content. Even though the number of *Azotobacter* present in this soil may have been adequate to fix a measurable amount of nitrogen, the organisms were of little value in increasing the nitrogen content of the soil. The results of this study indicate that *Azotobacter* will appear naturally in soil unfavorable for their growth when the unfavorable conditions, such as low pH and deficiency of available phosphorus and potassium, have been corrected, and that under certain cropping systems they may be of considerable importance in maintaining or increasing the nitrogen content of the soil.

TABLE 6.—Occurrence of *Azotobacter* in Richland silt loam under four cropping systems, six-year period

Cropping System	Beginning	Year 1st	2nd	3rd	4th	5th	6th
Clover and grass, ½ clippings returned	0	0	0	0	++	+	++
Grass, ½ clippings returned	0	0	0	0	+	+	+
Cotton after legume green manure	0	0	+	+	+	++	+++
Cotton with fertilizer nitrogen	0	0	+	++	+	+++	++++

Note: The number of *Azotobacter* colonies developing on plaques in 72 hours is indicated as follows:

+	1 to 20 *Azotobacter* per gram of soil.
++	20 to 200 *Azotobacter* per gram of soil.
+++	200 to 400 *Azotobacter* per gram of soil.
++++	Over 400 *Azotobacter* per gram of soil.

A summary of the gains and losses of nitrogen in the soil under the four cropping systems for the six-year period is shown in Table 7. The nitrogen content of the soil, as determined by chemical analysis, is shown at the beginning and after six years. Fertilizer nitrogen was added to the soil under two cropping systems. During the six years all the plots received 56 pounds of nitrogen per acre in rainfall as shown by analysis of the water for each rain or storm period. Measured removals of nitrogen from the soil are shown. They include that present in harvested crops and the nitrate and ammonium nitrogen leached from the soil by percolation water. By adding the fertilizer nitrogen and that contained in rain water to that present in the soil at the beginning of the study and subtracting from the sum that quantity of nitrogen removed in harvested crops and that removed by leaching, a calculated balance was obtained. This calculated balance represented the amount of nitrogen that should have been present in the soil at the end of the six-year period if all nitrogen additions and losses had been accounted for by soil, water and plant analyses. Then, by subtracting the calculated balance from the actual amount of nitrogen present in the soil as shown by chemical analysis at the end of the period, the net gain in nitrogen for each of the four cropping systems was obtained.

TABLE 7.—Gains and losses of nitrogen in Richland silt loam in lysimeters under four cropping systems, 6-year period

Nitrogen	White clover and Dallisgrass, ½ clippings returned N. Lbs./A.	Dallisgrass, ½ clippings returned N. Lbs./A.	Cotton after vetch as green manure N. Lbs./A.	Cotton with fertilizer nitrogen N. Lbs./A.
In soil at beginning	1,527	1,360	1,527	1,487
Added in fertilizer	0	204	0	408
Added in rainfall	56	56	56	56
Removed in crops	667	126	359	264
Removed by leaching	76	42	206	142
Calculated balance	840	1,452	1,018	1,545
Net gain (probably fixed)	1,233	381	1,142	68
Fixed annually	206	64	190	11
In soil after six years	2,073	1,833	2,160	1,613
Increase in soil nitrogen	546	473	633	126
Annual increase in soil nitrogen	91	79	106	21

This net gain in nitrogen, or at least a considerable part of it, can be attributed to nitrogen fixation. Contributing to the net gains, or losses had net losses occurred, were both symbiotic and nonsymbiotic nitrogen fixation on the one hand and losses of nitrogen by volatilization on the other. These are considered to be the only mechanisms by which additions or losses of nitrogen could have occurred that could be specifically measured in this study. In accounting for the net gains in nitrogen that occurred, it is doubtful whether much nitrogen could have been lost by volatilization since conditions of soil reaction, excess water or presence of a large quantity of inorganic nitrogen never existed in the soil for long periods.

In accounting for unmeasured additions of nitrogen, it is apparent that the *Azotobacter* were responsible for some nitrogen fixation, particularly where grass sod was grown without legumes. Symbiotic nitrogen fixation was responsible for the larger nitrogen accumulations that occurred in the two cropping systems where legumes were grown. Average annual net gains of 206 and 190 pounds of nitrogen per acre occurred in cropping systems where inoculated legumes were grown, the first in the clover and grass system and the second where cotton followed legume green manure. No fertilizer nitrogen was added to the soil in these two cropping systems.

The increase in the nitrogen content of the soil for the six-year period was obtained by subtracting that present in the soil at the beginning from that present in the soil after six years. The increase in the nitrogen content of the soil under the four cropping systems for the six years was 546 pounds per acre with clover and grass, 473 with grass alone, 633 with cotton following legume green manure and 126 for cotton with fertilizer nitrogen. The annual increases in soil nitrogen were 91, 79, 106 and 21 pounds per acre under the four cropping systems, respectively.

The nitrogen removed in harvested plant material was largest on the plots cropped continuously to clover and grass, where one-half the forage produced was removed. The nitrogen removed during the six years was 667 pounds per acre. In spite of this large harvest of nitrogen, this cropping system was responsible for an increase in soil nitrogen of 91 pounds per acre per year.

It may be noted that, of the four cropping systems used, cotton following an inoculated legume used as green manure resulted in the largest increase in soil nitrogen, 106 pounds of nitrogen per acre per year. Of the 184 pounds of nitrogen per acre per year contained in the vetch, 106 pounds of this amount remained each year in the soil humus. Thus, it appears that about one-half of the nitrogen from the heavy crop of the inoculated winter legume contributed to the organic matter buildup in the soil, at least for a six-year period. It should be pointed out that, as shown in Table 3, a heavy tonnage of the legume was turned under each spring. The average was 2.5 tons per acre on the dry-weight basis, and this plant material contained an average of 184 pounds of organic nitrogen. It should also be pointed out that the soil in all the plots was kept limed to near pH 6.5, and 72 pounds per acre each of P_2O_5 and K_2O were applied each spring, so that the level of the major nutrients was adequate for vigorous growth of the legumes. The hairy vetch was seeded at the rate of 30 pounds per acre. The seed were inoculated and planted about October 1 each fall, and appreciable growth was obtained before cold weather in December. The legume was turned into the soil about

March 10-15. All the nitrogen removed by crops from the cultivated plots was in the cotton seed. All the other plant material, except cotton lint, was left on the plots.

The magnitude of nitrogen losses by leaching was influenced by the cropping system and by the amount of nitrogen present in the soil. As would be expected, the presence of a continuous cover reduced leaching losses. On the plots cropped to cotton the loss was larger where more nitrogen was present. In six years 1,103 pounds of nitrogen were returned to the soil in legume green manure and 206 pounds, or 18.7 per cent, were lost by leaching. Four hundred eight pounds of fertilizer nitrogen were added to the soil where cotton was grown with fertilizer nitrogen and 142 pounds, or 35 per cent of the quantity added, were lost by leaching. It is apparent that the presence of the legume during the winter reduced leaching losses of nitrogen and at the same time increased the nitrogen content of the soil by symbiotic nitrogen fixation. Leaching losses and crop removals of nitrogen were lowest from soil where continuous grass was grown. The *Azotobacter* population in this soil, although it never became very large, was probably responsible for much of the increased nitrogen content. The nitrogen-fixing efficiency of the organisms present may have been increased as a result of a suitable energy supply and a low nitrogen content in the grass residue.

The nitrogen and organic matter contents of the soil were increased slightly by nitrogen fertilization and cotton crop residue. One of the three replicates of this treatment showed a net loss in soil nitrogen over the six-year period.

SUMMARY AND CONCLUSIONS

A lysimeter experiment was conducted to determine the influence of four cropping systems on the gains and losses of nitrogen and the accumulations of nitrogen and organic matter in Richland silt loam, a Mississippi terrace soil, for a six-year period. The four cropping systems were: (1), continuous cover of white clover and Dallisgrass with one-half the clipped forage returned to the soil surface; (2), continuous Dallisgrass with one-half the clipped forage returned to the soil surface; (3), cotton following an inoculated winter legume turned into the soil as green manure; and (4), cotton grown with 60-72 pounds of fertilizer nitrogen per acre, one-half the nitrogen applied at planting and the remainder used as a side dressing.

The pH of the soil was maintained near 6.5 by additions of dolomitic limestone. The soil in all plots was fertilized with available phosphorus and potassium each spring at the rate of 72 pounds per acre each of P_2O_5 and K_2O.

The study was continued for seven years and the last six years' results are reported here. During the course of the study the amounts of nitrogen added in fertilizer and in rainfall and the amounts removed in harvested plant material and lost by leaching were measured. Soil analyses were made annually and at the beginning and at the end of the six-year period for nitrogen and organic matter content. From the data obtained the changes in nitrogen and organic matter contents of the soil were determined and the following conclusions drawn:

1. Water losses by percolation were influenced more by the nature and distribution of rainfall than by total amount of rainfall or cropping system. An average of about 50 per cent of the rainfall was lost by percolation during the six-year period. The largest percolation, 76.9 to 85.4 per cent of the rainfall, occurred during a year when total rainfall was near average but when a few heavy rains fell on wet soil.

2. Nitrogen brought down to the soil in rain water varied from 4.0 to 13.3 pounds per acre per year and averaged 9.4 pounds. An average of 54 per cent of the nitrogen in the rainfall was ammonium nitrogen. The remainder was in the nitrate form.

3. Nitrogen losses by leaching varied from 2.0 to 95.4 pounds per acre per year. Losses were reduced by the presence of continuous cover. In the cultivated plots nitrogen losses were larger from the soil where more nitrogen was accumulating. During one year of the experiment nitrogen losses by leaching from soil cropped to cotton were equivalent to over two-thirds of that added as fertilizer.

4. Grass without clover could not be produced without occasional additions of fertilizer nitrogen. A mean annual yield of 4,722 pounds of clover and grass was obtained when one-half the forage was returned and no fertilizer nitrogen added. The average annual nitrogen removal in the harvested forage was 111 pounds per acre in clover and grass and 21 pounds in grass grown with fertilizer nitrogen.

5. Inoculated legumes produced an average of 5,108 pounds of dry matter, which was turned under as green manure before cotton was planted. This material contained an average of 184 pounds of nitrogen per acre per year. Approximately one-half this amount of nitrogen became available for the succeeding cotton crop and produced an average of 21 per cent more seed cotton than 72 pounds of fertilizer nitrogen.

6. The average annual increase in nitrogen was 206, 64, 190 and 11 pounds per acre, respectively, for the clover and grass, grass alone, cotton after vetch and cotton with fertilizer systems. The average annual increase in the nitrogen content of the soil under each of the four systems was 91, 79, 106 and 21 pounds per acre, respectively. The mean annual increase of 190 pounds of nitrogen per acre in the system where leguminous green manure was grown was about equal to the 184 pounds of nitrogen turned under each spring in the legume green manure. The annual accumulation in soil nitrogen was equal to slightly over one-half the amount of nitrogen turned under in the legume green manure.

7. The two cropping systems, (1) continuous clover and grass with half the forage returned to the soil surface and (2) cotton following legume green manure, gave significant increases in the nitrogen and or-

ganic matter contents of the soil as compared with cotton grown with fertilizer nitrogen. The quantity of cotton-crop residue that was produced with annual applications of fertilizer nitrogen was not sufficient to appreciably increase soil nitrogen and organic matter.

8. The nonsymbiotic nitrogen-fixing bacteria of the genus *Azotobacter* appeared in the soil when conditions favorable for their growth had been established. These organisms were of some value in increasing the nitrogen content of the soil. Their principal effect was apparent in the soil under grass sod, where an average of 64 pounds of nitrogen per acre per year accumulated. The grass residue with a relatively low nitrogen content provided a suitable energy source for nitrogen fixation.

LITERATURE CITED

1. Acharya, C. N., Jain, S. P. and Jha, J. Studies on the building up of soil fertility by the phosphatic fertilization of legumes. Influence of growing Berseem on the nitrogen content of the soil. Jour. Indian Soc. Soil Sci. 1:55-64. 1953.
2. Allison, F. E. The enigma of soil nitrogen balance sheets. Advances in Agronomy VII: 213-250. Academic Press Inc., New York, 1955.
3. Allison, F. E., and Sterling, Luann D. Nitrate formation from soil organic matter in relation to total nitrogen and cropping practices. Soil Sci. 67: 239-252. 1949.
4. Allos, H. F., and Bartholomew, W. V. Effect of available nitrogen on symbiotic fixation. Soil Sci. Soc. Amer. Proc. 19:182-184. 1955.
5. Andrews, W. B. Cotton Production, Marketing and Utilization. W. B. Andrews, State College, Miss. p. 84. 1950.
6. Broadbent, F. E., and Chapman, H. D., A lysimeter investigation of gains, losses, and balance of salts and plant nutrients in an irrigated soil. Soil Sci. Soc. Amer. Proc. 14: 263-267. 1949.
7. Broadbent, F. E, and Stojanovic, B. F. The effect of partial pressure of oxygen on some soil nitrogen transformations. Soil Sci. Soc. Amer. Proc. 16: 359-363. 1952.
8. Chapman, H. D., Liebig, G. F, and Rayner, D. S. A lysimeter investigation of nitrogen gains and losses under various systems of cover cropping and fertilization, and a discussion of error sources. Hilgardia 19: 57-128. 1949.
9. Cope, J. T., Jr., Sturkie, D. F., and Hiltbold, A. E. Effects of manure, vetch, and commercial nitrogen on crop yields and carbon and nitrogen contents of a fine sandy loam over a 30-year period. Soil Sci. Soc. Amer. Proc. 22: 524-527. 1958.
10. Fribourg, H. A., and Bartholomew, W. V. Availability of nitro-

gen from crop residues during the first and second seasons after application. Soil Sci. Soc. Amer. Proc. 20:505-508. 1956.

11. Giddens, Joe. Rate of loss of carbon from Georgia soils. Soil Sci. Soc. Amer. Proc. 21:513-515. 1957.
12. Goring, C. A. I., and Clark, Francis E. Influence of crop growth in mineralization of nitrogen in the soil. Soil Sci. Soc. Amer. Proc. 13: 261-266. 1948.
13. Haas, H. J., Evans, C. E., and Miles, E. F. Nitrogen and carbon changes in Great Plains soils as influenced by cropping and soil treatment. U.S.D.A. Tech. Bul. 1164. 1957.
14. Haddon, C. B. Experiments with legumes at the Northeast Louisiana Experiment Station. La. Agr. Exp. Sta. Bul. 477. 1953.
15. Jacobson, H. G. M., Swanson, C. L. W., and Smith, Evelyn. Effect of various fertilizer cations and anions on soil reaction, leaching, nitrification of urea, and related characteristics in an uncropped soil. Soil Sci. 65:437-460. 1948.
16. Jenny, Hans. A study of the influence of climate upon the nitrogen and organic matter content of the soil. Mo. Agr. Exp. Sta. Bul. 152. 1930.
17. Karraker, P. E. Effect of certain cropping and management practices on soil nitrogen content. Ky. Agr. Exp. Sta. Bul. 561. 1951.
18. Karraker, P. E., Bortner, Charles E., and Fergus, E. N. Nitrogen balance in lysimeters as affected by growing Kentucky bluegrass and certain legumes separately and together. Ky. Agr. Exp. Sta. Bul. 557. 1950.
19. Parker, D. T., Larson, W. E., and Bartholomew, W. V. Studies on nitrogen tie-up as influenced by location of plant residues in soils. Soil Sci. Soc. Amer. Proc. 21:608-612. 1957.
20. Patrick, W. H., Jr., Haddon, C. B., and Hendrix, J. A. The effect of longtime use of winter cover crops on certain physical properties of Commerce loam. Soil Sci. Soc. Amer. Proc. 21:366-368. 1957.
21. Pinck, Louis A., Allison, Franklin E., and Sherman, Mildred S. Maintenance of soil organic matter: II. Losses of carbon and nitrogen from young and mature plant materials during decomposition in soil. Soil Sci. 69:391-401. 1950.
22. Piper, C. S. Soil and Plant Analysis. Interscience Publishers, Inc., New York. 1950.
23. Reynolds, E. B., and Norris, M. J. Effects of legumes in different cropping systems on the yield of corn. Soil Sci. Soc. Amer. Proc. 16: 189. 1952.
24. Sackett, Walter G., and Stewart, Laura C. A bacteriological method for determining mineral soil deficiencies by use of the soil plaque. Col. Agr. Exp. Sta. Bul. 375. 1931.
25. Singh, Gangadhar, and Shrikhande, J. J. Non-symbiotic nitrogen fixation by *Azotobacter*. I. Effect of phosphorus on fixation. Jour. Indian Soc. Soil Sci. 1:47-54. 1953.

26. Soulidas, D. A., and Clark, Francis E. Nitrification in grassland soils. Soil Sci. Soc. Amer. Proc 22:302-311. 1958.

27. Stojanovic, B. J., and Broadbent, F. E. Immobilization and mineralization rates of nitrogen during decomposition of plant residues in soil. Soil Sci. Soc. Amer. Proc. 20:213-218. 1956.

28. Van Eseltine, William P. Occurrence of *Azotobacter* in certain Western South Carolina soils. Soil. Sci. 81:29-32. 1956.

29. Vyas, N. D. Effect of some indigenous phosphates on the fixation of atmospheric nitrogen through pea. Jour. Indian Soc. Soil Sci. 1: 41-46. 1953.

30. Vyas, N. D., and Desia, J. R. Effect of different doses of superphosphate on the fixation of atmospheric nitrogen through pea. Jour. Indian Soc. Soil Sci. 1:32-40. 1953.

31. Waggoner, B. E. Vetch good as a nitrogen source. Miss. Farm Research V-21, No. 10, P. 4, Oct. 1958. Miss. Agr. Exp. Sta.

32. Wagner, G. H., and Smith, J E. Nitrogen losses from soil fertilized with different nitrogen carriers. Soil Sci. 85:125-129. 1958.

33. Wilson, J. K. The production of microscopic colonies on plaques of soil. Jour. Amer. Soc. Agron. 29:286-292. 1937.

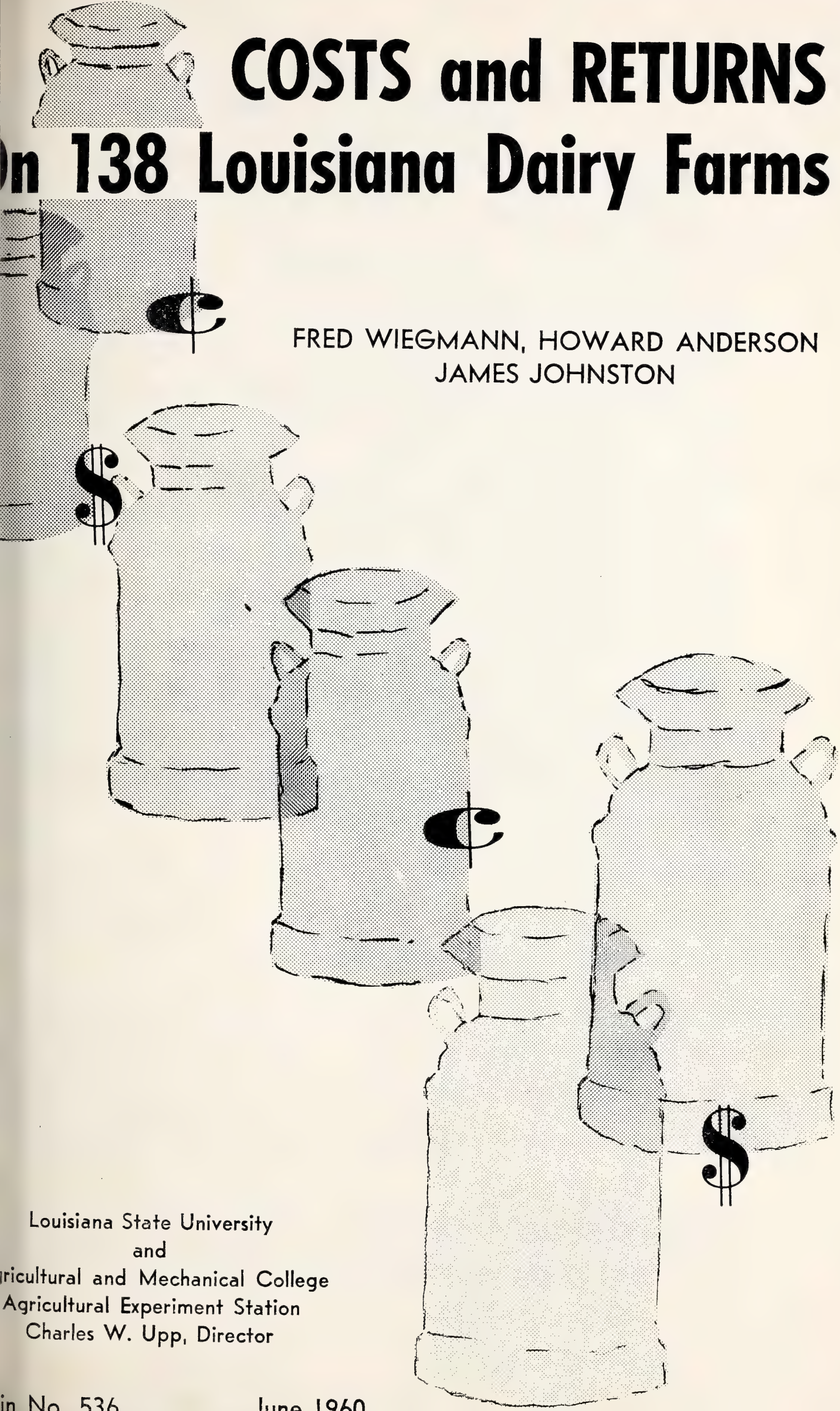
34. Wilson, J. K. The number of colonies on plaques of soil made from samples taken from various horizons. Soil Sci. Soc. Amer. Proc. 1:205-209. 1937.

35. Wilson, J. K. The legume bacteria liberate gaseous nitrogen from nitrate. Soil Sci. Soc. Amer. Proc. 12:215-216. 1948.

36. Winogradsky, S., and Ziemiecka, J. Etudes sur la microbiologique du sol. Sur le pouvoir fixateur des terres. Ann. Inst. Pasteur. 42:36-62. 1938.

COSTS and RETURNS
On 138 Louisiana Dairy Farms

FRED WIEGMANN, HOWARD ANDERSON
JAMES JOHNSTON



Louisiana State University
and
gricultural and Mechanical College
Agricultural Experiment Station
Charles W. Upp, Director

in No. 536 June 1960

TABLE OF CONTENTS

Pag

I. INTRODUCTION 3
II. PRODUCTION COSTS 3
III. OBJECTIVES OF STUDY 4
IV. SOURCE OF DATA 4
- Accounting and Analytical Procedures 5

V. ANALYSIS OF COSTS 7
- Investment and Labor 8
- Costs in Relation to Production 9
- Average Costs 11
- Per Cent Distribution of Costs 14
- Costs Related to Size of Milking Herd 15
- Costs, Income, and Production Per Cow 19
- Returns From the Dairy 21

VI. SUMMARY AND CONCLUSIONS 23
- "Cost of Producton" and Administered Prices 25

VII. Appendix 26

Costs and Returns On 138 Louisiana Dairy Farms

FRED WIEGMANN, HOWARD ANDERSON, and JAMES JOHNSTON[1]

INTRODUCTION

The dairy industry is an important part of Louisiana's economy. In 1959 there were approximately 3,950 commercial herds in the state. From 1949 to 1958 cash receipts from milk produced in Louisiana increased from $23,425,000 to $36,401,000. This was an increase from 7.5 per cent to 9.3 per cent of cash receipts from all farm commodities.

In recent years numerous changes have taken place in the dairy industry, many of them on the dairy farm. Mechanization is a good example. A few years ago most milking was done by hand. Now, milking machines are used on 99 per cent of Louisiana's dairy farms. Some dairymen have installed pipeline systems and about 75 per cent of the producers are now using bulk tanks. Tractors, silage and haying equipment and other modern machines are necessary on modern dairy farms. Barns and milk houses have been improved considerably over the last 10 years or so.

Improvements in physical facilities and equipment have required increasingly greater investments. The resulting increase in "overhead" cost has made it necessary for dairymen to increase the average size of their herds in order to spread these "overhead" costs over more production (thus reducing the cost per pound of milk).

Variable costs have also increased. That is, the costs of power, labor, mixed feeds, veterinary services, and supplies, have been changing rapidly in recent years, mostly upward.

PRODUCTION COSTS

Production costs are of concern in any business since costs, along with prices, determine profits. High costs result in lower net returns in the dairy business unless higher prices more than compensate for the high costs, and low costs increase net returns unless there is a greater decline in gross income.

Two aspects of costs are of particular importance. One is the relationship of cost to the size of the operation. The other is th level of cost at any given level of operation.

---

[1] Dr. Wiegmann is Head, Department of Agricultural Economics at L.S.U. Dr. Anderson is Specialist in Dairying, Louisiana Extension Service. Dr. Johnston is Professor of Dairying. The authors are indebted to Professor W. H Alexander for critical review of the manuscript and to the county agents who cooperated in providing much of the data.

Other cost relationships are also of considerable interest an importance. The percentage distribution of costs between item such as feed, labor, seed, fertilizer, interest on investment, etc have an important bearing on profits. Production costs per cow ar also closely related to profits.

A knowledge of average costs in the dairy industry is useful i a number of ways. One important use is for comparison. A dairy man may examine the various cost relationships in other dairie and compare them with similar data for his own operation. Thi can tell him whether he is above or below the general "average and may lead to needed changes in his business. Such data are useful also to financing institutions, to educational and service agencies, and to other groups allied with the dairy industry.

While a knowledge of production costs is always helpful, it becomes particularly important after some major changes have occurred in an industry, which could be expected to significantl affect levels and relationships between costs.

OBJECTIVES OF STUDY

This study is concerned with identifying and measuring some o the more important costs of milk production in Louisiana. Cost are separated into various categories and related to size of operation. Percentage distribution of costs, costs and production per cow and costs and size of milking herd are included in the analysis.

The relationship of gross and net income to costs, size of herd and production per cow is also shown.

SOURCE OF DATA

Business analyses for 1957 were taken on 138 dairy herds a shown in Table I. Data for the study were obtained from dairie enrolled in the Farm and Home Development Program in Louisiana. The dairies were located in 14 Louisiana parishes (Figure 1)

The records from which the data were obtained were in th files of county agents in the parishes. (The farm records are detailed, and maintained in connection with the Farm and Home Development Program.) Only specialized dairy farms were used i the study, except in cases where dairy costs and returns could definitely be identified and separated from other enterprises. The original data were obtained from farmers by personal interview and i most cases were verified by receipts or other records.

Inventory values were determined jointly by Extension agent and the farmers in the Farm and Home Development Program Cash receipts and cash expenses were obtained from records. Hour of labor on each farm were estimated by the Extension agents.

TABLE I.—Distribution of Sample of Producers and Production by Size Groups, 138 Dairy Farms, Louisiana, 1957

Farm Size Group (Production Per Year)	Number of Producers in Study	Per Cent of Producers in Group	Per Cent of Total Milk Produced by Group
Pounds of Milk	No.	Per Cent	Per Cent
50,000-100,000	16	11.59	4.91
100,001-150,000	40	28.99	20.16
150,001-200,000	32	23.19	21.69
200,001-250,000	23	16.67	20.30
250,001-300,000	16	11.59	16.88
300,001-350,000	5	3.62	6.42
over 350,000	6	4.35	9.64
Totals	138	100.00	100.00

Accounting and Analytical Procedures

Costs were broken down into the following three major categories for much of the analysis and discussion: (1) cash costs, (2) cash costs plus depreciation on buildings and equipment and interest on investment, and (3) total production costs. Each of these has implications for particular kinds of decisions. *Depending on the farmer's individual situation, any one of these categories may be the basis for a rational decision. An understanding of these categories of costs is necessary to understand the analysis in this study. They are defined below.*

(1) *Cash costs* include items used in production of milk for which cash expenditures were made each year. Expenditures for feed, labor, fertilizer, seed, utilities, milk hauling, etc., are examples. Many dairymen make management decisions only on a cash cost basis. Depreciation on buildings and equipment, interest on investment, and the value of unpaid family labor are not considered.

(2) *Cash costs plus depreciation and interest* includes all cash costs *plus* depreciation on equipment and farm buildings and interest on investment (excluding the operator's residence). After these costs have been deducted from total receipts the remainder is income for family living and is called "returns to labor and management." Many dairymen should include depreciation and investment charges, along with cash costs, in making management decisions.

(3) *Total production costs* in this study include all charges listed in (2) above *plus* a charge for family and operator's labor, valued at 50 cents per hour. After deducting total production costs from total receipts, the remainder is "returns to management."

Cash cost may be the basis for rational decisions by a small operator who owns his farm, equipment and livestock, has no inten-

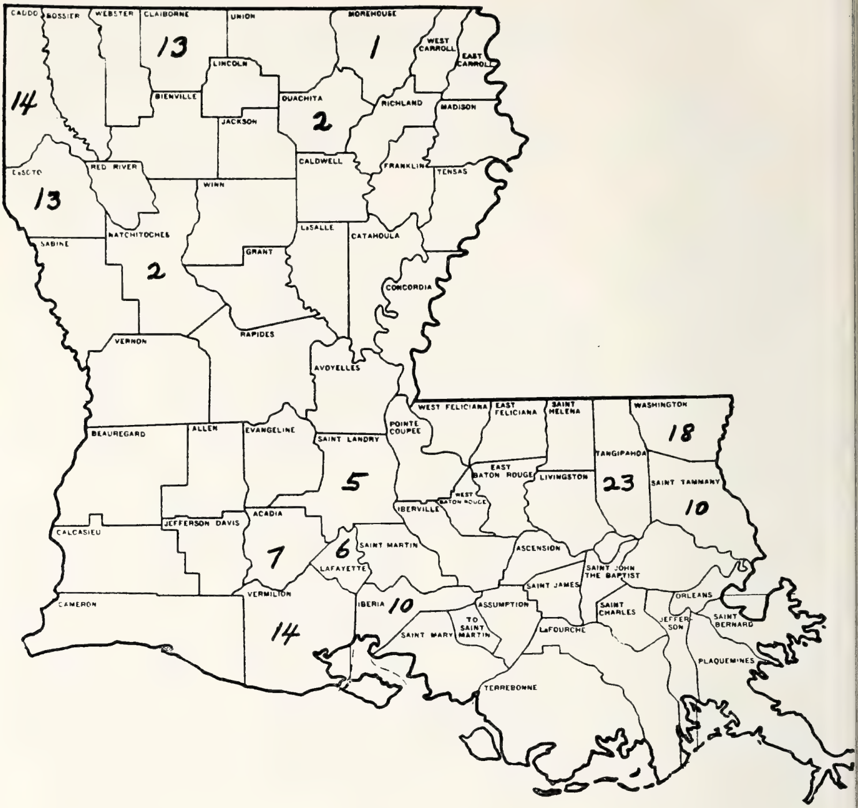


Figure 1. Location and Number of Sample Farms, 138 Dairy Farms, Louisiana, 1957.

tion of selling out, and uses only family labor. The operator of larger farm under mortgage who uses a lot of hired labor and equi ment is more likely to base decisions on (2) or (3) above.

The relationship of *each* of the above classifications of cost t volume of production is shown in this study. Costs were also relate to average milk production per cow. Many cost records are based o milk production per cow.[2]

Costs were also calculated for the three categories noted abov (i.e. cash costs, cash costs plus depreciation and interest, and tota costs) in terms of percentages of total cost. These percentage fig ures may serve as guides or "bench marks" for individual dair men in analyzing costs on their own dairies.

A standard depreciation rate of 8 per cent was used for a equipment. The operator's residences were not included in the far inventories due to the wide differences in values of homes not related to the farm's productivity, and because an on-site home is not essential to the operation of the dairy as a business unit.[3] All other buildings and silos on the farms were depreciated at 4 per cent. Interest on investment was computed at 4 per cent per year.

---

[2] Most U.S.D.A. records (including Dairy Herd Improvement and Weig a-Day-a-Month) are computed on the basis of average production per co

Land values were based on the average price paid for farm land during the years 1952 through 1956.[4] Land was neither depreciated nor appreciated for this study. Dollar values for "farm privileges" were not computed in this study because of the difficulty of determining such values.[5] However, farm privileges plus 50 cents per hour was considered to be a fair payment for family labor.

Livestock were neither depreciated nor appreciated in this study. Expenses for raising replacements were included in farm expenses and animals sold as culls or for other reasons were credited to farm income. Also, no attempt was made to adjust milk prices for variations in butterfat content. Most of the herds included Holstein and Jersey cows with some Guernseys in a few herds. There were few purebred animals on the farms in the study.

Statistical procedures were used in the analysis of the data.[6]

ANALYSIS OF COSTS

"Cost of Production" often differs considerably depending on what is included in the analysis. A number of different cost concepts are included in this analysis. In this section the following classifications of costs are related to size of operation as measured by annual milk production: (1) total costs, (2) average costs, and (3) per cent distribution of costs. Costs are also related to (1) size of milking herd and (2) average production per cow in the milking herd.[7]

---

[3] Since values of farm homes were not included in the inventories, total investments are slightly lower than would otherwise be true.

[4] Bueford M. Gile, *Farm Real Estate Prices in Louisiana by Parishes, 1952-1956*. L.S.U. Experiment Station, DAE Circular No. 206, June 1957, pp. 1-10. Adjustments were made in prices paid for land in Iberia and St. Tammany parishes because of the great increase in land values in 1955 and 1956.

[5] "Farm privileges" include such items as milk, butter, eggs, vegetables, etc., produced and consumed on the farm. These have some value and thus are generally considered part of the payment to the farm operator.

[6] Scatter diagrams or "dot charts" were plotted relating various cost items to the size of the business. The nature of the scatter suggested a straight line (direct) positive relationship in terms of total costs and an inverse relationship in terms of unit costs. Regression methods were used to fit straight lines to the data. Average costs per unit of production were determined by dividing the various total cost classifications by the associated levels of output.

[7] The "milking herd" is defined to include those cows that have freshened one or more times.

Investment and Labor Requirements

Investment in Relation to Total Production

Total investment per farm and average investment per 10 pounds of milk produced are shown in Table II for various siz dairies (measured by output of milk per year). Average investmen per farm varied from $9,000 to $60,000 on the farms in this study

Average investment per farm increased by about $6,455 fo each 50,000 pound increase in milk production per year (Table II) Average investment per 100 pounds of milk decreased with increased production. For example, when total output increased from 50,000 to 100,000 pounds of milk, the average investment decrease $2.39 per 100 pounds of milk produced. This compares with a decrease of only 16 cents per 100 pounds of milk produced when production per year increased from 250,000 to 300,000 pounds. The decrease in average investment per 100 pounds of milk produced wa fairly rapid up to about 200,000 pounds production per year, wher it tended to level out.

TABLE II.—Investment Per Farm and Per 100 Pounds of Milk, 138 Dair Farms, Louisiana, 1957

Pounds of Milk Produced Per Year (1)	Total Investment Per Farm (2)	Average Investment Pe 100 Pounds of Milk (3)
50,000	$ 8,843	$17.69
100,000	15,298	15.30
150,000	21,753	14.50
200,000	28,208	14.10
250,000	34,663	13.87
300,000	41,118	13.71
350,000	47,573	13.59
400,000	54,028	13.51
450,000	60,483	13.44

Labor

The amount of labor used in the operation of the 138 farm varied widely, as shown in Figure 2. Some of the dairies producin 400,000 pounds of milk per year did not use any more total hour of labor than others producing 100,000 pounds per year. At an level of production, the total amount of labor used varied by 3,00 to 5,000 hours *for the same level of output*. Possibly some of th wide differences in amount of labor used was due to the use o pipeline milkers and bulk tanks on some farms and machine milkers and can coolers on others.[8] Differences in production per cov

---

[8] Some farms used women and children, while in others only men wer employed.

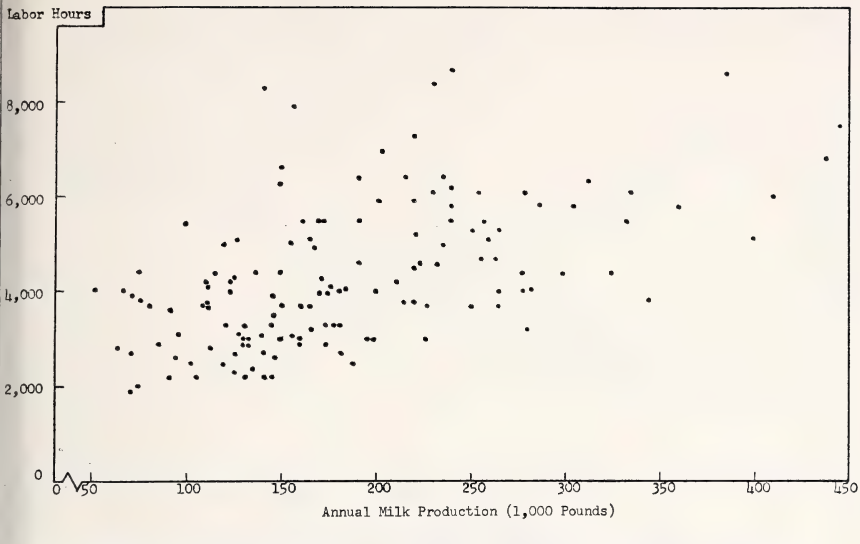


Figure 2. Labor Hours, 138 Dairy Farms, Louisiana, 1957.

also undoubtedly accounted for some labor differences, as substantially the same labor is required in handling and milking high producing cows as compared to low producers. Errors in estimating labor must be considered also. *Still, the data indicate that some dairymen are not utilizing their labor efficiently.*

Costs in Relation to Production

In order to relate costs to levels of production the following cost concepts were used: total costs, average costs, and per cent distribution of costs. For the major part of the analysis, costs were separated into three categories. These were: (1) cash costs, (2) cash costs plus depreciation on buildings and equipment and interest on investment, and (3) total production costs (which includes number (2) above *plus* the value of family and operator's labor).[9]

Because of the variation in costs associated with differences in size of operation, *a single average cost of milk production* (for example, $5.54 per 100 pounds produced) *cannot be representative of all production groups*. Such a figure is "representative" only of the average farm that is near the average in production (185,313 pounds). Even this is a fairly misleading statement. At a particular level of production there is a wide variation of costs among individual producers (See Figure 4). A single average cost usually understates total costs for most small producers and overstates them for most medium volume and large producers.

---

[9] See page 5 for definition of these categories.

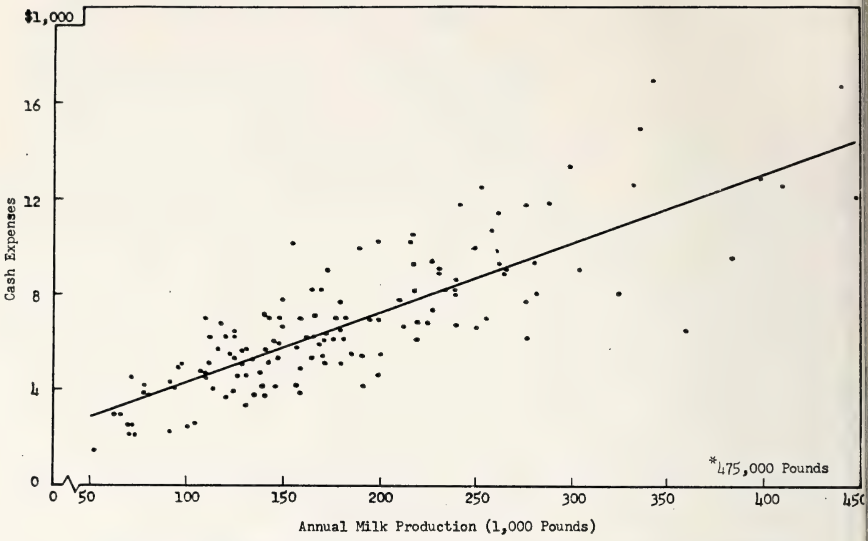


Figure 3. Cash Expenses, 138 Dairy Farms, Louisiana, 1957.

Cash Costs as Related to Production

The relationship of total cash cost to annual milk production is shown in Figure 3 and Table III. Average total cash costs of milk production increased as volume of production increased; for example, from $2,836 at the 50,000 pound level of production to $8,774 at 250,000 pounds and to $14,712 for 450,000 pounds. The wide difference in costs between farms for the *same* level of production should particularly be noted (Figure 3).

TABLE III.—Average Total Costs of Milk Production, 138 Dairy Farms Louisiana, 1957

Pounds of Milk Produced Per Year (1)	Total Cash Costs Per Farm (2)	Total Cash Costs Plus Depreciation and Interest Per Farm (3)	Total Costs Per Farm* (4)
50,000	$ 2,836	$ 3,700	$ 5,070
100,000	4,320	5,443	6,941
150,000	5,806	7,176	8,812
200,000	7,289	8,909	10,682
250,000	8,774	10,642	12,553
300,000	10,258	12,375	14,423
350,000	11,742	14,108	16,294
400,000	13,227	15,841	18,164
450,000	14,712	17,574	20,035

*Column 3 plus the value of operator and family labor.

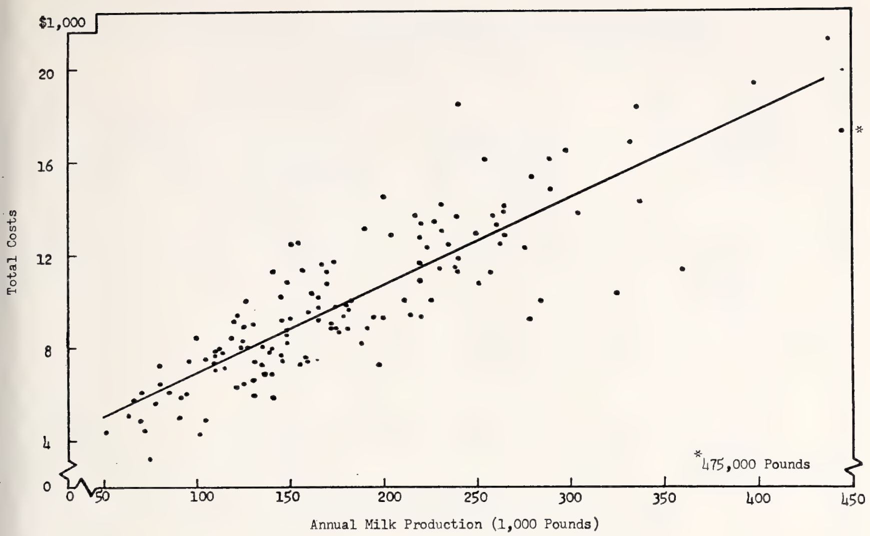


Figure 4. Total Costs (Including Cash Expenses, Depreciation, Interest, and a Charge for Family Labor) 138 Dairy Farms, Louisiana, 1957.

Cash Costs Plus Depreciation and Interest as Related to Production

Adding depreciation on buildings and equipment and interest on investment to cash costs results in increasing costs with increasing volumes, as shown, but at a higher level than in Figure 3 (for cash costs). This trend is also noted in Table III. Average total cash costs plus depreciation and interest increased as volume of production increased.

Total Costs as Related to Production

Total costs of milk production, which includes cash costs, depreciation on buildings and equipment, interest on investment, *and* value of unpaid family and operator's labor, are shown in Table III for various size dairies (measured by output of milk per year). The same information is shown graphically in Figure 4. The line graph shows the average amount that total costs of production increased as the size of the producing unit increased ($1,870 for each 50,000 pounds increase in milk production). Again, *particular attention should be given the wide differences in costs between dairies of the same size.* (Each dot represents the cost and volume of production of one dairy.)

Average Costs

The data in Table IV is derived from the totals in Table III. Total costs have been divided by total production to arrive at an average cost per 100 lbs. The data are shown graphically as "average cost curves" in Figure 5. In the short run it is obvious that

TABLE IV.—Average Costs of Milk Production (Per 100 pounds), 138 Dairy Farms, Louisiana, 1957

Pounds of Milk Produced Per Year (1)	Average Cash Costs Per 100 Pounds (2)	Average Cash Costs Plus Depreciation and Interest Per 100 Pounds (3)	Average Total Costs Per 100 Pounds (4)
50,000	$5.67	$7.41	$10.14
100,000	4.32	5.44	6.94
150,000	3.87	4.78	5.87
200,000	3.64	4.45	5.34
250,000	3 51	4.26	5.02
300,000	3.42	4.13	4.81
350,000	3.35	4.03	4.66
400,000	3.31	3.96	4.54
450,000	3.27	3.91	4.45

all *cash costs* must be covered. However, in the long run costs of *all* factors of production must be covered by the selling price, or producers should put their resources into more profitable uses. As economic conditions change, adjustments are often necessary and, in cases where short run average costs of production are not being met, producers must either enlarge their operations, operate more efficiently, or both, or go out of business.

Cash Costs Per 100 Pounds of Milk Produced

As shown in Figure 5 and Table IV, average cash costs (cash cost per 100 pounds of milk produced) fall fairly rapidly up to about 100,000 pounds of production (line C, Figure 5). The average price received for milk by the 138 producers in 1957 was $5.54 per 100 pounds (line D). Average *cash costs* were covered by price at about 51,000 pounds of milk annually (where line C meets line D). The money remaining after cash costs are met is available for family living, savings, and new investment in the business but does not provide a return for the use of the capital already invested in the business.

Cash cost was $2.16 more per 100 pounds of milk produced at the 50,000 pound level than at 250,000 pounds (Table IV). In contrast, the difference in cash costs was only 24 cents less per 100 pounds of milk produced when total output was 450,000 pounds than when it was 250,000 pounds. Thus, while cash costs per 100 pounds decrease with output, most of the decrease comes at the lower levels of production (50,000-250,000 pounds per year).

Cash Costs Plus Depreciation and Interest Per 100 Pounds of Milk

Many dairymen tend to think only of the *cash costs* of operating a dairy. Because of an increasingly large capital investment in

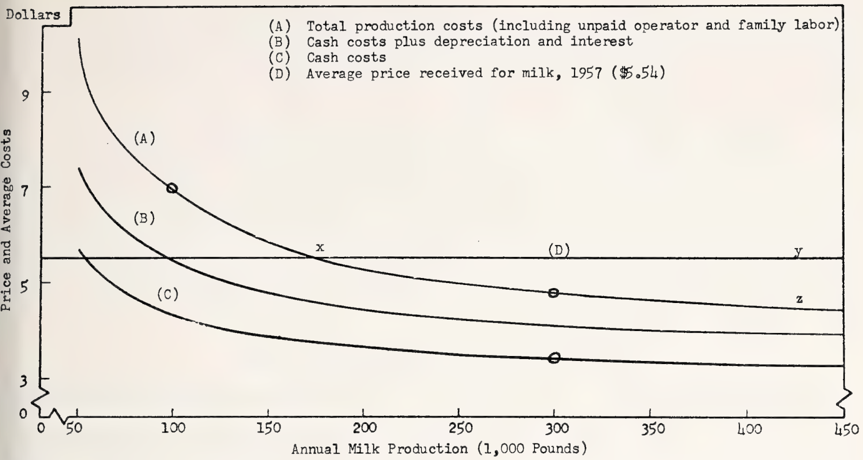


Figure 5. Average Costs Per 100 Pounds of Milk Produced, and Price, 138 Dairy Farms, Louisiana, 1957.*

equipment and buildings, and the fact that these must eventually be replaced in order to continue operating, a charge for depreciation and interest on these items should be added to cash costs. If the money invested in the dairies were invested in other enterprises some annual return would be expected. Thus a reasonable amount of interest on investment should also be included in costs, since interest is the normal return to capital. Producers utilizing unpaid family labor are usually not so interested in "total" production costs as they are in "returns to labor and management" *after* cash costs, depreciation and interest are deducted, since this would be income available for family living. These latter costs are shown by line graph B in Figure 5 and column 3, Table IV.

As noted (by line B, Figure 5) average cash costs plus depreciation and interest were covered by price in 1957 at about 97,000 pounds of milk production. According to these data, a dairy farmer received no return for his labor and management until over 97,000 pounds of milk per year were produced.

The *average* cost of milk production *per 100 pounds* (including depreciation and interest) decreased rapidly from $7.41 at a level of 50,000 pounds to $4.26 at 250,000 pounds (Table IV, Column 3). Between production levels of 250,000 and 450,000 pounds, these average costs (per 100 pounds produced) declined only 35 cents.

Total Production Costs Per 100 Pounds of Milk

When a charge for unpaid family and operator's labor was included, together with cash costs, depreciation and interest, a minimum of about 180,000 pounds of milk production annually was ne essary before all costs were covered (line A, Figure 6). Theoret cally, the area xyz (Figure 5) would be "excess profits," since a production costs were covered.[10]

---

*This chart shows the relationship between average costs, under three categories of cost, and the level of production. Total production cost per 100 pounds of milk was $6.94 at 100,000 pounds. At 300,000 pounds of milk annually total average production cost declined to $4.81 per 100 pounds. Cash costs were $3.42 per 100 at 300,000 pounds of production (circled point).

Average total costs per 100 pounds of milk produced (Table IV decreased as output increased, as was expected. The average tot cost per 100 pounds of milk was $5.12 less when production wa 250,000 pounds per year than was the cost per 100 pounds to pr duce 50,000 pounds. The decrease in average total cost was only 5 cents per 100 pounds when production increased from 250,00 pounds to 450,000 pounds.

Per Cent Distribution of Costs

Costs were broken down into the following categories: feed, fe tilizer, seed, cash labor, real estate and income taxes, insurance, i terest on borrowed capital, "other" items (which includes mil hauling, supplies, breeding fees, equipment and building repair veterinarian supplies, gas and oil, utilities, rent, machine hire, etc. depreciation on buildings and equipment, interest on investmen and unpaid family and operator's labor. These were then convert to percentages. The purpose of such extensive breakdown was t show the distribution of costs within the categories outlined o pages 5 and 6 in this report. Individual dairymen's costs may b compared with the average costs of the dairy farms included in th study. For some items, cost, the percentage cash costs, cash cos plus depreciation and interest, and total costs did not differ great at various levels of production. They are shown in Appendix T bles A1, A2, and A3. A summary or average for *all levels of pr duction* is given in Table V and Figure 6.

Feed cost (Figure 6 and Column 1, Table V) was the large single item of expense and represented about 49 per cent of cas costs, 40 per cent of cash costs plus depreciation and interest, an 33 per cent of total production costs. The second largest item cost of milk production was for "other items" which includes mil hauling, building and equipment repairs, along with other misce laneous expenses, and represented 25.37, 20.68 and 17.15 per ce of the total by categories (Column 8, Table V).[11]

---

[10] The authors recognize that 50 cents per hour plus farm privileg may be a low labor charge for the operator's labor. Also depreciation a interest on the operator's residence was purposely not included. Had the charges been included, average costs of these 138 dairy farms would ha been slightly higher and the equilibrium point, as far as production p year is concerned, would probably have been nearer 200,000 pounds. T operator's residences were left out of the computations because of t very great variation in values. These variations could not be related to t efficiency of the dairy as a producing firm.

[11] While it was not done here the "other items" category would ha been more useful had it been further broken down in this analysis.

Fertilizer and cash labor were the next largest items of cash costs, amounting to 9.85 and 7.80 per cent, respectively. Taxes, insurance, seed, and interest on borrowed capital together accounted for only 7.69 per cent of cash costs.

After including charges for depreciation on buildings and equipment and interest on investment, feed, as a percentage of total costs, dropped to 40.19 per cent (Column 1, Table V). Interest on investment entered as 12.57 per cent (later dropping to 10.43 per cent when family and operator's labor was included).

When unpaid family labor was added to the above costs, feed amounted to 33.33 per cent of total cost. This change in percentage is due in part to the fact that unpaid family and operator's labor accounted for 17.07 per cent of total costs (Column 11, Table V).[12] When family labor is charged as a cost, the value of unpaid family and operator's labor plus cash labor was 22.34 per cent of the total costs of milk production for the farms included in this study. Feed, labor, "other" cash items, depreciation on buildings and equipment, and interest on investment, make up 88.14 per cent of the total costs of milk production when family labor is included as a cost.

Costs Related to Size of Milking Herd

Distribution of farms in each herd size group was somewhat "skewed" (concentrated toward smaller herds, Column 2, Table VI) with the largest number of producers having 21 to 40 cows per herd.

The average investment per farm (Column 4, Table VI) increased from $17,471 average for herds having from 10 to 21 cows to a $47,886 average investment for herds having between 61 and 99 cows. The over-all average investment for the 138 farms was $26,312, with an average of 38 cows per herd.

Investment per 100 pounds of milk produced (Column 5, Table VI) decreased from an average of $18.55 for the herds having 10 to 20 cows to $12.71 for herds averaging 51 to 60 cows. The 61- to 99-cow group averaged $17.26 investment per 100 pounds of milk produced which, as shown in Table VI, did not follow the trend, a declining average investment as herd size increased, set by the other size groups.[13]

---

[12] This may be a low per cent in some cases where no child labor was used. In these cases the operator's labor or other adult unpaid labor could have been valued at more than 50 cents per hour. For purposes of standardization a value of 50 cents per hour was used as an average figure for all unpaid labor.

[13] This may have been due to the small number of herds (only 11) in this classification. Also, producers with some of the larger herds had recently gone into the dairy business from "row crop" farming and were "over-invested" in buildings and equipment.

TABLE V.—Per Cent of Costs For Various Items, Average of All Levels of Production, 138 Dairy Farms, Louisiana, 1957*

Classification of Costs	Feed (1)	Ferti- lizer (2)	Seed (3)	Cash Labor (4)	Taxes[2] (5)	Insur- ance (6)	Interest on Bor- rowed Capital (7)	Other Items[3] (8)	Depre- ciation on Bldg. and Equip- ment[4] (9)	Interest on Invest- ment[5] (10)	Unpaid Family and Opera- tor's Labor (11)
	Per Cent										
Cash Costs	49.29	9.85	3.37	7.80	.39	1.20	2.73	25.37	....	....	....
Cash Costs Plus Depreciation on Buildings and Equipment and Interest on Investment	40.19	8.03	2.75	6.36	.31	.98	2.23	20.68	5.90	12.57	....
Total Costs Including Cash, Depreciation on Buildings and Equipment and Value of unpaid Family and Operator's Labor[1]	33.33	6.66	2.28	5.27	.26	.81	1.85	17.15	4.89	10.43	17.07

*Breakdown at various levels of production is shown in Appendix Tables A1, A2, and A3.

[1] Unpaid family and operator's labor was valued at $0.50 per hour (no dollar value was placed on farm perquisites).

[2] Only real estate and income taxes were included.

[3] Includes milk hauling, veterinarian expense, utilities, supplies, breeding fees, etc.

[4] Buildings were depreciated at 4 per cent per year; equipment at 8 per cent per year.

[5] Figured at 4 per cent for total investment excluding operator's residence

TABLE VI.—Investment and Components of Cost in Relation to Size of Milking Herd, 138 Dairy Farms, Louisiana, 1957[1]

Number of Cows in Herd (1)	Number of Farms (2)	Number of Cows (3)	Average Investment Per Farm[2] (4)	Average Investment Per 100 Lbs. Milk Produced[2] (5)	Cash Expense Per 100 Lbs. Milk Produced (6)	Cash Expense Plus Depreciation and Interest Per 100 Lbs. Milk Produced[3] (7)	Total Production Costs Per 100 Lbs. Milk Produced[4] (8)	Variable Costs Per 100 Lbs. Milk Produced[5] (9)	Fixed Costs Per 100 Lbs. Milk Produced[6] (10)
10-20	9	165	$17,471	$18.55	$3.61	$4.72	$6.29	$3.39	$1.33
21-30	44	1,153	19,233	14.28	3.79	4.63	5.80	3.58	1.05
31-40	38	1,363	24,643	13.69	3.61	4.41	5.39	3.48	.92
41-50	21	958	30,082	13.68	3.74	4.56	5.35	3.57	.98
51-60	15	841	35,501	12.71	3.62	4.38	5.16	3.48	.90
61-99	11	818	47,886	17.26	3.91	4.90	5.55	3.79	1.11
Totals and Averages	138	5,298	$26,312	$14.20	$3.70	$4.53	$5.47	3.54	$ .99

---

[1] This applies to cows that have freshened once or more.

[2] Excludes operator's residence.

[3] Includes depreciation on equipment (8 per cent annually) and all buildings (4 per cent annually), except operator's residence, and 4 per cent interest on investment.

[4] Includes unpaid family and operator's labor valued at $0.50 per hour.

[5] Excludes family labor.

[6] Includes depreciation on buildings and equipment and interest on investment. The addition of variable and fixed costs **will not equal total costs,** but rather cash costs plus depreciation on buildings and equipment and interest on investment, because family labor was not included in either column 9 or 10 in this table.

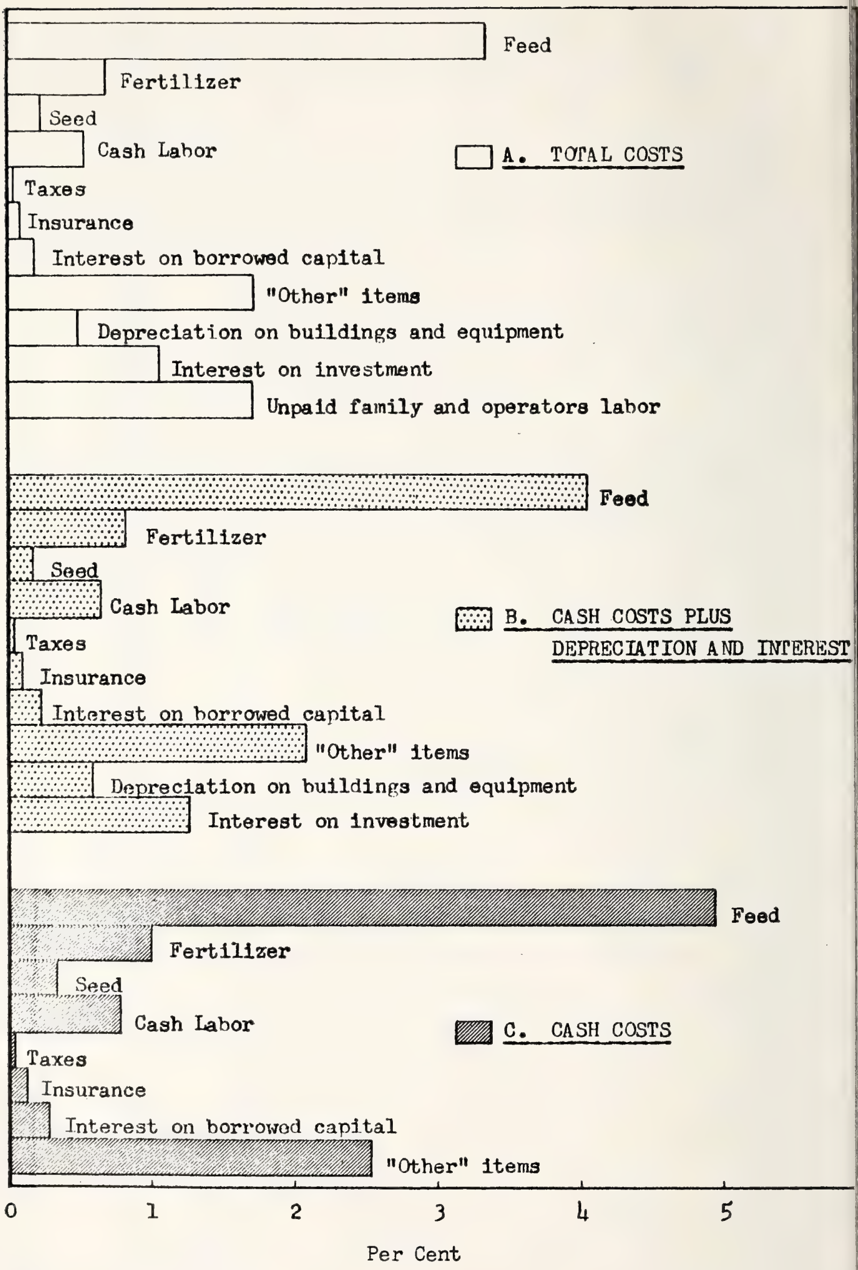


Figure 6. Per Cent Distribution of Costs in Three Categories of Cost, 13
Dairy Farms, Louisiana, 1957.

Cash expenses per 100 pounds of milk produced averaged $3.70 and varied slightly in different groups with no consistency. This was also true with regard to "cash costs plus depreciation and interest" (Column 7, Table VI), which averaged $4.53 per 100 pounds.

Total production costs, per hundred pounds of milk, including the value of unpaid family and operator's labor, decreased from $6.29 in the 10- to 20-cow herds to $5.16 in herds having between 51 and 60 cows. In the group having 61 to 99 cows, total production costs averaged $5.55 per 100 pounds of milk produced. The data suggest that a minimum-size economic family dairy production unit in Louisiana, based on these 138 farms, is about 35 cows if production per cow is about 5,000 pounds of milk per year.[14]

Variable costs (Column 9, Table VI) showed no consistent change as the size of the herds increased. Average variable costs per farm was $3.54 per 100 pounds of milk produced.

Fixed costs (Column 10, Table VI) showed a reduction per 100 pounds of milk produced, as herd size increased, from $1.33 average in herds with 10 to 20 cows to an average of 90 cents in the 51-60-cow group. The average fixed costs per 100 pounds of milk produced on all 138 farms was 99 cents (not including operator's residence).

Costs, Income, and Production Per Cow

Cost and income per cow was studied in relation to average annual milk production per cow (Table VII). Average production per cow varied from 2,000 pounds to over 8,000 pounds annually. The largest number of cows (1,713) averaged 4,001 to 5,000 pounds production per cow.

Cash expenses per cow (Column 4, Table VII) increased from $114.57 for those averaging 2,000 to 3,000 pounds of milk per year to $252.98 in the herds averaging over 8,000 pounds of milk per year. Cash expenses plus depreciation and interest increased, for these same groups, from $145.42 to $299.30 per cow, respectively (Column 5, Table VII). Total production expenses (Column 6, Table VII) likewise increased, from $175.89 in the herds where average production per cow was 2,000 to 3,000 pounds to $357.26 per cow in the group averaging over 8,000 pounds of milk per cow per year.

While expenses per cow increased with higher production per cow *income per cow increased even more.* Thus, *net income also increased as production per cow increased.*

---

[14] Based on combined conclusions from Table VI and Figure 5. Note that total costs per 100 pounds production fell below average price ($5.54) at about 180,000 pounds annual production (Figure 5), and average total production costs fell below $5.54 in the 31-40-cow herds (Table VI). This also agrees with data in column 9, Table VII, and in Figure 7.

TABLE VII.—Costs and Income Per Cow, From Milk, in Relation to Average Production Per Cow, 138 Diary Farms, Louisiana, 1957[1]

Average Production Per Cow (1)	No. Farms (2)	No. Cows (3)	Cash Expense Per Cow (4)	Cash Expense Plus Depreciation and Interest Per Cow (5)	Total Production Expense Per Cow[2] (6)	Net Cash Income Per Cow[3] (7)	Income for Family Living Per Cow[4] (8)	Net Income Per Cow[5] (9)
2,000 to 3,000 lbs.	8	420	$114.57	$145.42	$175.89	$ 48.04	$ 6.39	$—13.28
3,001 to 4,000 lbs.	29	1,130	144.90	183 63	221.50	76.68	34.10	— 3.77
4,001 to 5,000 lbs.	45	1,713	170.66	209.35	261.23	104.59	60.42	8.59
5,001 to 6,000 lbs.	32	1,238	201.06	242.06	284.26	131.06	83.35	41.16
6,001 to 7,000 lbs.	10	331	237.78	289.95	338.10	140.03	90 89	42.74
7,001 to 8,000 lbs.	9	290	237.53	288.72	348.93	173.50	122.31	66.27
Over 8,000 lbs.	5	176	252.98	299.30	357.26	257.88	184.38	153.60

---

[1] Based on **income from milk alone,** not gross farm income.

[2] Includes unpaid family and operator's labor valued at 50 cents per hour.

[3] Cash expenses only are deducted from milk receipts.

[4] Cash expenses, plus 8 per cent depreciation on farm equipment and 4 per cent on farm buildings (excluding operator's dwelling), and 4 per cent interest on investment are all deducted from milk receipts.

[5] Value of unpaid family and operator's labor as well as cash expenses and depreciation on buildings and equipment are all deducted from milk receipts.

Net cash income (profit based on total milk receipts minus cash costs) per cow increased from $48.04 in the group averaging 2,000 to 3,000 pounds (Column 7, Table VII) to $257.88 per cow in the group averaging over 8,000 pounds of milk per cow per year.

Income for "family living" per cow (Column 8, where cash expenses, depreciation on buildings and equipment and interest on investment were deducted from milk receipts) showed an increase from $6.39 per cow in the 2,000 to 3,000 pound group to $184.38 per cow in herds averaging over 8,000 pounds of milk per cow.[15]

Net income per cow (where *all costs including family labor* have been deducted, Column 9, Table VII) shows an average loss of $13.28 in herds averaging 2,000 to 3,000 pounds of milk per cow per year and a net loss of $3.77 per cow in the herds averaging between 3,001 and 4,000 pounds per cow. Average net income per cow then increased from $8.59 in the herds with an average production of 4,001 to 5,000 pounds per cow to $153.60 per cow in the group with over 8,000 pounds average production.

Returns from the Dairy

Returns to the dairy are shown in Table VIII. Cash costs, cash costs plus depreciation on buildings and equipment, and total production costs are shown graphically in Figure 7 as they relate to milk sales and gross returns[16] to the farm for various sizes of producing units (measured by output of milk per year). The relationship between total costs and returns shown in Figure 7 is the familiar "breakeven" concept of economic theory. The "breakeven point" is at that level of production where costs and returns are equal (break even). In Figure 7 the "breakeven" point for cash costs and returns from milk alone was at about 51,000 pounds of annual production, where line (B) meets line (E). For total costs and income from milk sales the "breakeven" point was around 180,000 pounds production, where line (B) meets line (C).

Cash Costs as Related to Total Milk Sales and Gross Returns

The "cash cost" line (Figure 7) is lower than the "milk sales" at all levels of production more than 51,000 pounds. This means that a profit over cash cost was realized only at sales above 51,000 pounds of milk. Cash expenses for milk production were more than

---

[15] Many dairy farmers consider only cash expenses and cash returns. The authors think that depreciation and interest on investment should be included in expenses. The amount left after these deductions gives the farmer's income for family living, or the "returns to labor and management." Where a farmer has no intention of selling his farm and keeps buildings and equipment in good condition through repair expenses, then cash expenses may be most meaningful.

[16] The difference in "milk sales" and "gross returns" is accounted for by value of animals sold, returns for use of equipment off the farm, and Government payments.

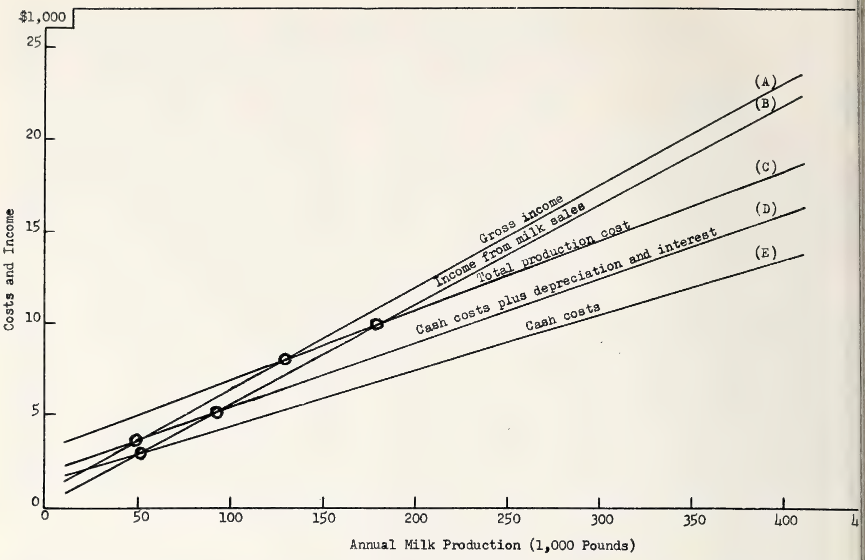


Figure 7. Total Costs and Returns, 138 Dairy Farms, Louisiana, 1957.

the "gross" returns at any level of production less than 20,00 pounds of milk annually.

The cost of all factors of production must be covered by incom in the long run or the producer would be better off using his resources elsewhere. However, for producers already owning thei farms and utilizing mostly unpaid family labor, cash costs may b the only costs considered by the operator in making production decisions.

Cash Costs Plus Depreciation and Interest as Related to Total Mil Sales and Gross Returns

After adding depreciation on buildings and equipment, and interest on investment to cash costs (Figure 7), the cost line (D) intersects milk sales at about 97,000 pounds of milk production pe year. This is in agreement with the average cost curves as show in Figure 5. This shows that production above 97,000 pounds o milk resulted in a profit above cash costs, depreciation on building and equipment, and interest on investment. This same line (D crosses the "gross" returns line at 50,000 pounds of milk production per year, indicating that gross returns were above this combination of costs at a lower level of production.

Total Costs as Related to Total Milk Sales and Gross Returns

Total production costs (line C, Figure 7) were above total mil sales up to about 180,000 pounds of milk production per year. (Thi is in agreement with average total costs in Figure 5.) This indicates that about 180,000 pounds of milk were needed to cover tota

TABLE VIII.—Total Milk Sales and Gross Returns, 138 Dairy Farms, Louisiana, 1957

Pounds of Milk Produced Per Year (1)	Average Total Milk Sales[1] (2)	Average Gross Returns to Farm[2] (3)
50,000	$ 3,071	$ 3,504
100,000	5,730	6,264
150,000	8,389	9,025
200,000	11,048	11,785
250,000	13,707	14,545
300,000	16,366	17,306
350,000	19,025	20,067
400,000	21,684	22,827
450,000	24,343	25,588

[1] Milk sales only.

[2] Includes animals sold, returns from use of farm and dairy equipment off the farm, and government payments as well as milk sales.

costs of production on the 138 dairy farms in 1957. In other words, at an annual production rate of about 180,000 pounds of milk in 1957, farmers in this study were at the "breakeven" point from the sale of milk alone.

Comparing total costs to gross returns (Figure 7) shows that "gross returns" (Line A) became greater than total production costs (Line E) at about 130,000 pounds of milk production per year. Thus, 130,000 pounds of milk had to be produced before all production costs were covered by gross returns. The latter figure is probably most realistic since most dairy farms do have some income from sources other than milk.

SUMMARY AND CONCLUSIONS

Total average investment per dairy farm increased from $8,843 at 50,000 pounds of annual production to $60,483 at 450,000 pounds of production on the 138 dairy farms in this study. Average investment per 100 pounds of milk produced decreased from $17.69, when 50,000 pounds were produced per year, to $13.87 when 250,000 pounds of milk were produced per year. This further decreased to $13.44 per 100 pounds of milk produced in herds where 450,000 pounds of milk were produced annually.

According to this study, labor used on dairy farms in Louisiana varied greatly at all levels of production. For example, labor used at production levels of 60,000 varied from 2,000 to 4,000 hours and at 150,000 pounds varied from approximately 2,000 to over 8,000 hours. Part of the difference may be due to use of pipeline milkers and bulk tanks, as well as other labor-saving equipment on some farms. *Undoubtedly a considerable amount of labor inefficiency is also present on some farms.* Production per cow plays an important

role. It is well known that high-producing cows require very li
tle, if any, more labor than low-producing ones.

Average costs per 100 pounds of milk decreased as the size c
the dairy enterprise increased (as measured by total pounds of mil
produced annually). Cash costs decreased from $5.67 per 100 pounc
of milk produced at a production level of 50,000 pounds per yea
to $3.51 per 100 pounds in herds producing 250,000 pounds annua
ly and to $3.27 per 100 pounds when herds produced 450,0C
pounds of milk per year. Cash costs plus depreciation on building
and equipment and interest on investment were $7.41, $4.26, an
$3.91, respectively, at 50,000 pound, 250,000 pound and 450,0C
pound production levels. Average total production costs (includin
unpaid family labor) were $10.14, $6.94, $5.87, $5.02, and $4.45 pe
100 pounds at the 50,000, 100,000, 150,000, 250,000, and 450,0C
pound levels of production.

The average price received for milk by the farms included i
the study was $5.54 per 100 pounds.

The average production per cow for all 5,298 cows included in th
study was 4,827 pounds per year. According to the data in the 13
herds studied, the "breakeven" point was at about 4,800 pounds c
milk per cow per year. At this rate of production *all* costs, incluc
ing family labor, were covered by returns.

This study showed that purchased feed was the largest singl
cash cost item in milk production (49 per cent of cash cost
Other "cost of milk production" studies are in substantial agree
ment with this percentage. Probably more progress can be made b
dairymen in lowering costs of milk production by reducing cost
of purchased feed than by reducing costs of any other single iten
The next largest cash cost item was "other costs" (25.37 per cent c
cash costs) including milk hauling, breeding fees, supplies, util
ties, veterinarian expenses, and other miscellaneous expenses. Man
of these items are incurred in direct relation to amount of mil
produced and probably cannot be reduced any appreciable amoun

While costs of milk production increased with average produc
tion per cow, *net* income per cow also increased. According to dat
on these 138 farms, *net income over cash cost* varied from $48 fc
3,000-pound-producing cows to $257 for 8,000 pounds or more prc
duction per cow. Net income per cow *over total costs* increase
from $8.59 in herds averaging between 4,001-5,000 pounds per co
per year to $153.60 in herds averaging over 8,000 pounds pe
cow per year. In herds where average production per cow wa
between 3,001 and 4,000 pounds of milk per year, average net los
per cow was $3.77.

A forty-cow milking herd[17] represents an economic family siz dairy enterprise in Louisiana, according to the data in this study. In 38 herds having between 31 and 40 cows, average *cash* production costs were $3.61 for each 100 pounds of milk produced. Smaller herds (21 to 30 cows) had an average cash production cost of $3.79. The average selling price was $5.54 for each 100 pounds of milk.

---

[17] The "milking herd" includes those cows that have freshened once c
more.

A minimum of about 180,000 pounds of milk per year was necessary for *milk sales* to cover *total* production costs on the farms in this study. About 130,000 pounds of milk production per farm was necessary for *gross returns* to the dairy to equal *total* costs.

This study shows that cash costs plus depreciation and interest on investment averaged $8,909 for the production of 200,000 pounds of milk in 1957. At this level of production $11,048 was received from the sale of milk alone. At this level of production this leaves a labor income from milk sales alone (money left for family living) of $2,141 per year. From average *gross returns* per farm, (milk sales plus other dairy income) the labor income or money available for family living averaged $2,876 at the 200,000 pound level of production. If only *cash costs* of production are considered, *net cash return over cost* was $4,496 at 200,000 pounds of production.

"Cost of Production" and Administered Prices

In connection with agricultural policy the suggestion is sometimes made that administered prices for agricultural products should be based on "cost of production." This cannot be considered a very sound economic system of pricing for most agricultural products. There are many producers, all operating under widely varying conditions. Thus there are *many different costs.*

As shown in this study, there were 414 different costs for the 138 dairy farms included (138 farms x 3 potentially rational categories of costs for each). This points up the basic problem involved immediately: which, or whose, cost should be used as a base for pricing?

Suppose, for the sake of argument, an arbitrary decision was made to use "that average cost which includes cash cost plus depreciation and interest on investment" (category 2 in this study) for a "representative" group of farms. But there is yet another question. A representative group for what level of production? As shown here *the average cost changes with every level of production* (see line B, Figure 5).

There are other complications. The problem is most complex. But this should be sufficient to indicate some very real and important obstacles to using "cost of production" as a major basis for pricing many agricultural products.

APPENDIX TABLE A1.—Per Cent of Cash Cost Expended on Various Cost Items, 138 Dairy Farms, Louisiana, 1957

Pounds of Milk Produced Annually	No. Farms	Feed	Fertilizer	Seed	Cash Labor	Taxes[1]	Insurance	Interest on Borrowed Capital	Other Items[2]
					Per Cent				
50,000 to 100,000	16	46.82	9.53	3.64	4.54	.0	1.23	5.18	29.06
100,001 to 150,000	40	48.75	10.27	3.55	6.82	.34	1.58	3.07	25.62
150,001 to 200,000	32	51.05	9.37	2.96	5.92	.36	1.12	3.00	26.22
200,001 to 250,000	23	51.17	9.62	2.82	8.95	.49	1.13	3.18	22.64
250,001 to 300,000	16	47.08	9.04	3.19	9.67	.43	1.08	1.88	27.63
300,001 to 350,000	5	46.62	9.31	4.35	14.27	.34	1.04	.88	23.19
Over 350,000	6	49.39	13.08	4.91	5.94	.57	.97	1.25	23.89
Total or Average	138	49.29	9.85	3.37	7.80	.39	1.20	2.73	25.37

[1] Real estate and income taxes only.
[2] Includes milk hauling, veterinarian expense, supplies, utilities, etc.

APPENDIX TABLE A2.—Per Cent of Cash Cost Plus Depreciation on Buildings and Equipment Expended on Various Cost Items, 138 Dairy Farms, Louisiana, 1957[1]

Pounds of Milk Produced Annually	No. Farms	Feed	Fertilizer	Seed	Cash Labor	Taxes[2]	Insurance	Interest on Borrowed Capital	Other Items[3]	Depreciation on Bldg. and Equipment	Interest on Investment
		Per Cent									
50,000 to 100,000	16	37.42	7.62	2.91	3.63	.0	.99	4.14	23.22	6.25	13.82
100,001 to 150,000	40	38.86	8.19	2.83	5.43	.27	1.26	2.45	20.43	6.36	13.91
150,001 to 200,000	32	41.93	7.70	2.43	4.86	.30	.92	2.46	21.54	5.28	12.58
200,001 to 250,000	23	41.89	7.88	2.31	7.33	.40	.92	2.61	18.53	5.96	12.18
250,001 to 300,000	16	38.61	7.41	2.62	7.93	.35	.88	1.54	22.66	6.09	11.90
300,001 to 350,000	5	39.54	7.89	3.69	12.10	.29	.88	.75	19.67	5.07	10.13
Over 350,000	6	40.34	10.68	4.01	4.85	.46	.80	1.02	19.52	6.20	12.13
Total or Average	138	40.19	8.03	2.75	6.36	.31	.98	2.23	20.68	5.90	12.57

---

[1] Buldings were depreciated on a 25-year basis (4 per cent per year) and equipment on a 12-year basis.
[2] Includes only real estate and income taxes.
[3] Includes milk hauling, veterinarian expense, supplies, utilities, etc.

APPENDIX TABLE A3.—Per Cent of Total Costs Expended on Various Cost Items, 138 Dairy Farms, Louisiana, 1957[1]

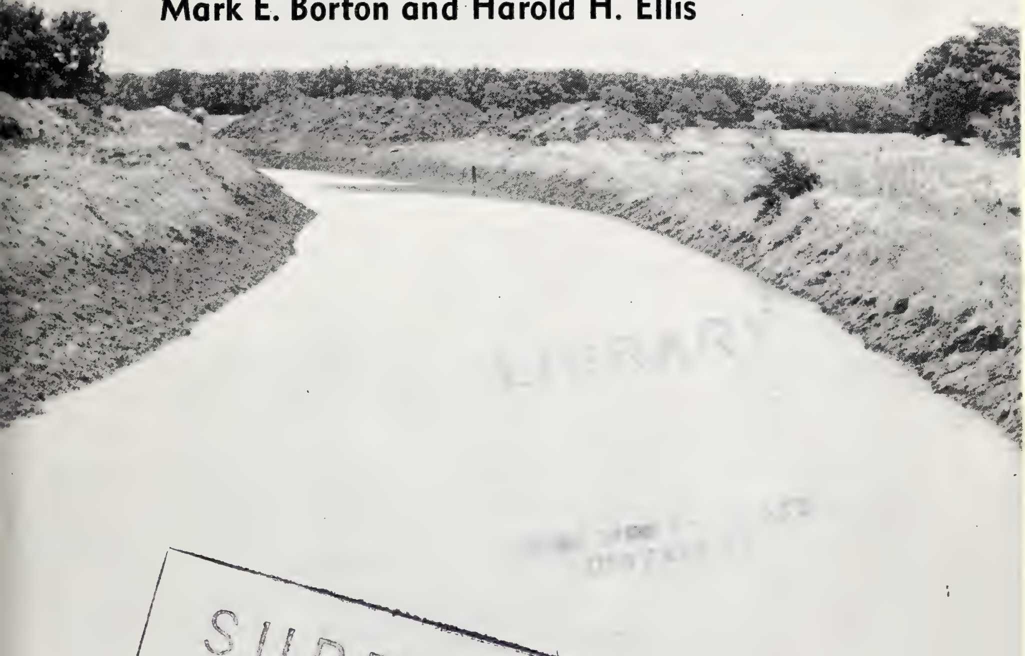
Pounds of Milk Produced Annually	No. Farms	Feed	Fertilizer	Seed	Labor	Taxes[2]	Insurance	Interest on Borrowed Capital	Other Items[3]	Depreciation on Bldg. and Equipment	Interest on Investment	Unpaid Family and Operator's Labor
						Per Cent						
50,000 to 100,000	16	27.44	5.58	2.14	2.66	.0	.72	3.03	17.02	4.59	10.13	26.69
100,001 to 150,000	40	31.58	6.65	2.30	4.41	.22	1.02	1.99	16.61	5.17	11.31	18.75
150,001 to 200,000	32	34.25	6.29	1.99	3.97	.24	.75	2.01	17.59	4.31	10.28	18.33
200,001 to 250,000	23	35.18	6.61	1.94	6.16	.33	.77	2.19	15.56	5.19	10.23	16.02
250,001 to 300,000	16	33.68	6.47	2.28	6.92	.30	.77	1.35	19.77	5.32	10.38	12.75
300,001 to 350,000	5	35.33	7.05	3.30	10.81	.26	.79	.67	17.58	4.53	9.05	10.64
Over 350,000	6	33.91	8.98	3.37	4.08	.39	.67	.86	16.41	5.21	10.49	15.94
Total or Average	138	33.33	6.66	2.28	5.27	.26	.81	1.85	17.15	4.89	10.43	17.06

[1] Includes value of unpaid family and operator's labor. This labor was valued at $0.50 per hour.
[2] Only real estate and income taxes.
[3] Includes milk hauling, veternarian expense, supplies, utilities, etc.

SOME LEGAL ASPECTS OF WATER USE

in Louisiana

Mark E. Borton and Harold H. Ellis



SURPLUS
TO REQUIREMENTS AS
Superceded
Worn Out
Obsolete
Unbindable
Duplicated
NMSU LIBRARY
LAS CRUCES

in No. 537
June 1960

uisiana State University and
ultural and Mechanical College

Agricultural Experiment Station
Charles W. Upp, Director

In Cooperation With
Farm Economics Research Division, Agricultural Research Service
United States Department of Agriculture

Foreword

Louisiana is blessed with an abundant supply of water for navigation, irrigation, and industrial and domestic use, as well as for fish and wildlife. The economic potential of this important resource has not yet been fully realized, nor has the destruction resulting from uncontrolled water been completely halted.

Louisiana's rice industry has long depended upon an abundant water supply for irrigation, but in recent years other segments of agriculture have also turned to supplemental irrigation and the increased use of water for other production purposes. These trends toward greater utilization of this resource are likely to continue, and perhaps at an accelerated pace.

The legal structure governing the rights of persons to appropriate, use, and dispose of water is very complex, and many problems will arise as water resources achieve greater economic importance. Constructive legislation may be needed to conserve this vital resource and encourage its most effective use. But sound regulation can best come from an informed public. It is for the purpose of promoting a better understanding of Louisiana water laws, particularly as they apply to agriculture, that the Louisiana Agricultural Experiment Station requested the Farm Economics Research Division, Agricultural Research Service, United States Department of Agriculture, to undertake a study of the legal aspects of water use in the state. It is believed that this carefully prepared report will contribute materially toward this objective.

M. D. Woodin and F. L. Corty
Department of Agricultural Economics
Louisiana State University

CONTENTS

Introduction 5
Natural Watercourses 9
  Definitions 9
  Nature of Riparian Rights 15
    Ownership of Beds 15
    Ownership of Water 17
    Right to Use Water 18
      Irrigation 20
      Contractual Agreements 23
      Domestic and Other Uses 23
      Pollution 24
      Diversion 28
      Dams and Obstructions 30
  Navigable Watercourses 32
    Definition 32
    Ownership of Beds 35
    Right to Use Water 38
  Nonriparian Use 44
  Nature of Riparian Land 47
    Construing Grants and Conveyances 48
    Shifting Shores and Channels 52
  Pollution Control by Public 55
Diffused Surface Waters 59
Ground Waters 63
Natural Lakes and Bayous 67
Artificial Watercourses 71
Prescription 74
1958 Declaration of State Policy Regarding Surface Waters 77
State and Local Agencies or Organizations 77
  State Department of Public Works 78
  State Stream Control Commission 79
  State Board of Health 79
  State Wildlife and Fisheries Commission 80
  State Geological Survey 80
  Police Juries 80
  Municipalities 81
  Irrigation Companies 82
  Irrigation Districts 84
  Waterworks Districts 88
  Soil Conservation Districts 88
  Sabine River Authority 90
  Bayou D'Arbonne Lake Watershed District 93
  Iatt Lake Water Conservation District 95
  Recreation and Water Conservation Districts 97
  Fish and Game Preserves 98
  Levee and Drainage Districts 99

Federal Watershed Protection and Flood Prevention Act 10
    Type of Assistance 10
    Conditions of Assistance 10
    Limitations on Size of Projects and Structures 10
Interstate Compacts 10
    Sabine River Compact and Administration 10
    Other Interstate Agreements and Arrangements 11
Appendix 11

Acknowledgement

Figures and photographs were provided through the courtesy the Louisiana Department of Public Works and the Louisiana Offi of the Soil Conservation Service, United States Department of Agricu ture.

Some Legal Aspects Of Water Use in Louisiana

Mark E. Borton and Harold H. Ellis*

Introduction

Water is one of Louisiana's most important natural resources and serves many vital needs. According to a recent report, Louisiana has an average rainfall of about 56 inches per year, nearly twice the national average.[1] But seasonal and yearly variations in this rainfall and its variations throughout the state cause problems of both water use and water damage. This is true also of water entering Louisiana from other states, through the Mississippi and other rivers and streams.

Furthermore, several types of water use have been expanding. It was reported that:

> Municipal use of water increased from 150 million gallons daily in 1950 to 242 million gallons daily in 1954.
>
> Industrial use jumped from 1,940 million gallons a day in 1950 to 3,750 million gallons a day in 1955.
>
> Rural use of water has almost doubled since 1950—from 47 to 85 million gallons a day.
>
> Irrigation water also showed an increase, with over one million acreage feet of water used in 1955—about 2,000 million gallons a day for a 160-day pumping season.
>
> . . . .
>
> The rivers, bayous, canals, and lakes are being used more and more for navigation, recreation, commercial fishing, sports, and disposal of waste. These are nonwithdrawal uses that are difficult to measure, but of great economic importance.
>
> . . . .
>
> Based on records of the past few years, it is reasonable to expect

---

* Mark E. Borton, L.L.B., formerly with the Farm Economics Research Division, Agricultural Research Service, United States Department of Agriculture; Harold H. Ellis, Agricultural Economist, Farm Economics Research Division, Agricultural Research Service, and member of the Illinois Bar.

The authors wish to acknowledge the helpful criticisms and suggestions of a number of state, federal, and local officials and other persons concerned with water use in Louisiana, especially (1) Mr. Fred Ellis, who reviewed the manuscript under the guidance of Dean Milton Harrison and Professor Joseph Dainow, The Law School, Louisiana State University and Agricultural and Mechanical College, (2) Dr. F. L. Corty, Department of Agricultural Economics, Louisiana State University, who handled publication details and related editorial work, and (3) Mr. Calvin T. Watts, Assistant Director, and other staff members of the Louisiana Department of Public Works, who provided information regarding a number of projects with which that department is concerned.

[1] *Water, A Special Report to the Louisiana Legislature,* by the Louisiana Department of Public Works, Baton Rouge, 1956.

> the use of water to be doubled in the next 10 or 15 years. Thi
> increase will be accompanied by conflicts of interests and competition among users.

. . . .

The 1954 Census of Agriculture reported 6,897 irrigated farms i Louisiana with 707,818 irrigated acres of cropland harvested (including 665,607 acres of rice).[2] Most of the irrigation was in southwester Louisiana. This irrigated land amounted to 136,153 acres more than th 571,665 acres reported for 1949.[3] Streams and lakes supplied somewha less of the 1949 irrigated acreage than did pumped wells, with miscellaneous sources providing the rest.

A capital investment of $21,503,040 in irrigation works was reporte in the 1950 Census. These works included dams, reservoirs, wells, an 3,477 miles of canals and ditches.[4] The irrigation enterprises wer classified as follows:

Type of Enterprise[5]	**Number**	**Acreage Irrigated**
Single-farm	3,584	342,590
Commercial	270	243,588
Unincorporated cooperative	47	15,735
Incorporated cooperative	4	1,574

Irrigation of rice has long been a common practice in Louisiana More recently, irrigation of other crops and pastures has been increasing, particularly in the northern half of the state. According to recent survey, the number of farms equipped for irrigation (other tha irrigation of rice) in 27 North Louisiana parishes increased from 12 i 1949 to about 466 in 1955, while the acreage equipped for irrigation increased from 566 to 39,610. Flooding is the standard method of irrigating rice, but methods of irrigating other crops and pastures include both flooding (31,454 acres) and sprinkling (20,681 acres). Most of thi irrigated acreage was from streams, lakes, and ponds, but the proportion using wells was increasing.[7]

---

[2] Not counting irrigated pasture or irrigated cropland not harvested and no pastured.

[3] See Table 21, 1954, Census of Agriculture, Vol. II, General Report; Parish Tables 1a and 9a, Vol. I, Part 24, Counties and State Economic Areas, Louisian (1954 Census); Parish Tables 1a and 5a, Vol. I, Part 24, Counties and Stat Economic Areas, Louisiana (1950 Census).

In addition to the 571,665 acres of cropland harvested in 1949, 4,434 acres o irrigated pasture and 676 acres of irrigated cropland not harvested and not pasture were reported. Similar data were not obtained in the 1954 Census.

[4] 1950 U.S. Census of Agriculture, Vol. III, Irrigation of Agricultural Lands, Par 8, Louisiana, State Table 2.

[5] An enterprise was classed as "commercial" if less than 50 percent of the acreag irrigated was in the farms of the water users that controlled and operated it. It wa classed as cooperative (or mutual) if it was controlled and operated by two o more water users primarily to supply water to their own farms. These classification do not necessarily correspond with legal classifications of enterprises in Louisian See *Irrigation Companies*, infra.

1950 U.S. Census of Agriculture, Vol. III, Irrigation of Agricultural Lands, Definitions and Part 8, Louisiana, State Table 2. (Comparable data were not obtained i the 1954 Census.)

[6] Acreage reported by more than one type of enterprise was included for each.

Irrigation is a seasonal use of water. Much of it takes place when natural streamflows are lowest and when several competing uses, for instance recreational and municipal uses, may be relatively intense. At such times, withdrawals for one or more types of use also may aggravate pollution problems.

With expanding uses of water for irrigation and other purposes, an increasing number of problems and potential conflicts concerning water use, disposal, and control may be expected—both among farmers and among the different segments of the state's economy. Moreover, an increasing need for development of natural water resources may be expected, such as the construction of dams to regulate and even out streamflows and provide storage of water for use in seasons of short natural supply. The Legislature in 1958, in an act declaring a state policy regarding surface waters and establishing a water resources study commission, noted that "continued waste, and misuse or lack of beneficial use of surface waters may create critical problems . . ."[8]

With this expanding activity, it is important for farmers and others to have a general understanding of their legal rights and responsibilities in utilizing and developing the various water resources in the state, including natural rivers, streams, lakes or bayous, artificial watercourses, diffused surface waters, and ground waters. Rights to use water may vary with the nature and type of the source. They may also vary with such factors as type and method of use and location of the land on which the water is used in relation to source of water.

Laws relating to water resources in Louisiana are embodied in: (1) the State's Constitution, Civil Code, Revised Statutes, and reported Supreme and Appellate Court decisions; (2) certain special or local laws enacted by the State Legislature that have not been incorporated in the Revised Statutes;[9] (3) Federal statutes, constitutional provisions, and court decisions; (4) certain rules and regulations promulgated by state-federal agencies; (5) local laws, such as parish or municipal ordinances; (6) certain interstate compacts or agreements; and (7) local court decisions not appealed from.

The discussion that follows deals with several features of the applicable water laws of Louisiana but is not exhaustive in these respects.

---

[7] Wiegmann, Fred H., and Koch, Kenneth A., *Trends in Irrigation in Louisiana,* Louisiana State University and A and M College, Agr. Expt. Sta., D.A.E. Circular No. 187, March, 1956. See also Wiegmann, Fred H., *General Crop Irrigation in 1955,* Louisiana State University and A and M College, Agr. Expt. Sta. Mimeo. Circular No. 179, April, 1955, p. 28.

[8] Louisiana Acts 1958, No. 363. See *1958 Declaration of State Policy Regarding Surface Waters.*

[9] It may be noted that L.S.A.—Const. of 1921, Art. 4, sec. 6, requires notice of intention to secure passage of a "local or special law" to be published, without cost to the state, "in the locality where the matter or things to be affected may be situated . . ."

Primary attention in this discussion will be given to state legislation incorporated in the Louisiana Civil Code and Revised Statutes, and the reported Supreme and Appellate Court decisions. The laws discussed herein relate to legal rights of individuals, organizations, and agencies concerning the ownership, use, control, or regulation of the various water resources in the state. Except as indicated otherwise, the discussion deals with the general rules of law that have been adhered to by the state's Supreme Court, in the absence of contractual agreements prescriptive rights, controlling statutes, or other complicating factors.

Louisiana law has its foundations in the French, Spanish, and Roman civil law, in contrast to other states whose foundations are in the common law of England (although court decisions in Louisiana have been influenced in various cases by common law principles followed in other states). While the similarities between the two systems are perhaps as striking as the differences, one major difference must be noted In general, in the common law, the law regulating relationships between individuals is formed largely in the courts through decisions of the judges in particular cases. Any legislation changing this "judge-made" law is viewed as a modification of this basic case law, while other legislation may merely codify it. But in the civil law, the basic law concerning relationships between individuals is found mainly in legslation rather than in case law. Case law has developed mainly to explain and illuminate this legislation. The result reached may be the same under either system, but the methods differ. One striking similarity is that the so-called riparian doctrine has been applied in various ways to the use of water in natural watercourses in Louisiana and several other states, particularly in the eastern United States. This has resulted primarily from legislative provisions in Louisiana, whereas in other states it has been primarily a development of the common law, although apparently based on some ideas borrowed from the French Civil Code.

The codification of the laws regulating relationships between individuals is the Louisiana Civil Code of 1870, as amended, while certain provisions added since 1870 appear in Title 9 of the Louisiana Revised Statutes. The Louisiana Revised Statutes (except for Title 9) contain legislation affecting public law; i.e., the law that governs relationships between individuals and the State or public. (The Louisiana Civil Code of 1870, Constitution of 1921 and earlier constitutions, and Revised Statutes of 1950, with amendments, are all embodied in Louisiana Statutes Annotated, which hereafter in this bulletin are referred to as L.S.A.)[10]

The primary objective of this discussion is an exploration of some of the legal aspects of water use in Louisiana, with primary emphasis on agricultural uses. Water use problems are increasing. In the past however, most disputes in Louisiana arising from water problems have centered around the rights and duties associated with the disposal of water through drainage; very few disputes have centered around the rights and duties associated with the use of water. Consequently, there has been little authority outside the Civil Code and some provisions of the Revised Statutes for answers to many of the questions that might be raised concerning water use. Usually the provisions of the Civil Code are deliberately couched in very general terms to cover the vast number of particular fact situations that might be presented. The scarcity of reported court decisions regarding water use makes it difficult to give precise answers to these questions. In several instances, only possible or probable answers are set forth.[11]

---

[10] For a more complete discussion of the nature of Louisiana's Civil Law and its relationship to the common law, see Dainow, Joseph, "Introductory Commentary to the Louisiana Civil Code," L.S.A.—Civil Code, Vol. 1, page 1.

In any event, as the laws may change and their application may depend on the particular circumstances of each case, the discussion that follows should not be regarded as a substitute for competent legal advice on specific problems.

Natural Watercourses

Definitions

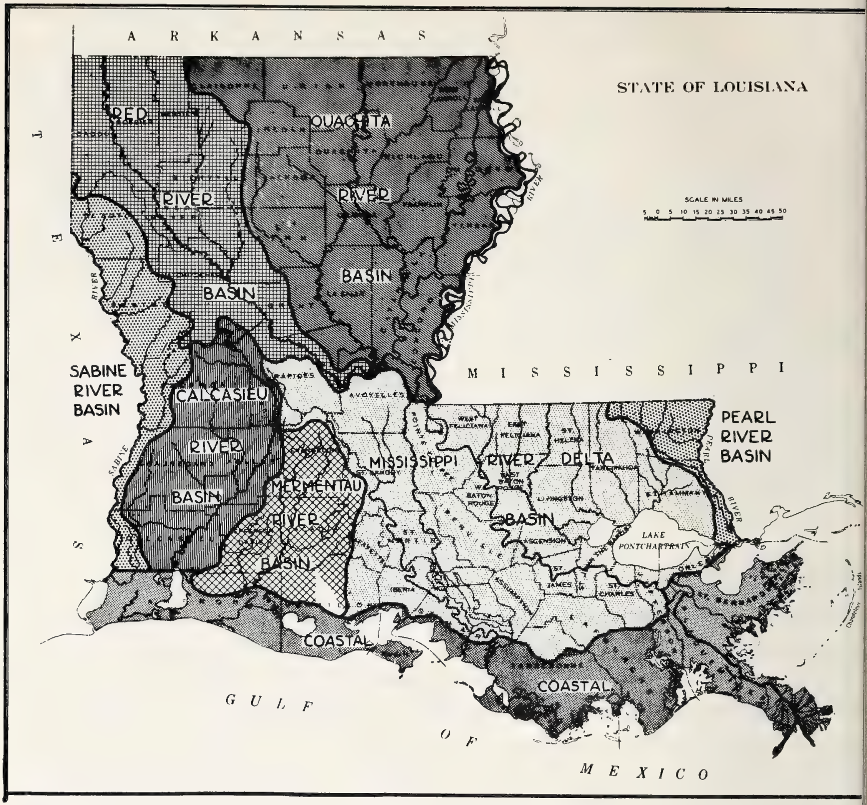
Various rights concerning the waters, beds, and banks of watercourses may depend on the definitions of and the distinctions between certain types of watercourses. In Louisiana, there are as yet no clear definitions or distinctions of this kind for the purpose of determining rights *to use the waters* of any watercourse, but certain definitions or distinctions have been made in cases in which other rights closely associated with watercourses were involved, such as drainage rights and ownership of beds, banks, and lands near or adjoining certain waters. Bear in mind, however, that the definitions and distinctions that are applicable in determining one set of rights (e.g., rights regarding beds and banks) may or may not be applicable in determining another set of rights (e.g., rights to use waters).

The Supreme Court of the state has never defined or distinguished between different bodies of water in its few cases that have dealt with the rights of persons to utilize water from them.[12] The principal Code

---

[11] Other discussions of various aspects of Louisiana water laws include: Walther, E. P., Jr., "Acquisition of the Right to Use Water." 29 Tulane Law Rev. 554 (1955); Jones, Jerry G., "Water Rights in Louisiana," 16 La. Law Rev. 500 (1956); and *Water Problems in the Southeastern States*, Research Report No. 5, Louisiana Legislative Council, Baton Rouge, April 7, 1955; revised and published as Research Study No. 11, December, 1957.

[12] The Second Circuit Court of Appeal decided a case in 1925 in which rights to the use of a bayou were involved. The court indicated that from the evidence it was not clear whether the bayou was "a running stream." It said, "we get the impression that it is not." The bayou was described as being about 2,000 feet long, 100 feet wide, and nonnavigable. But the court did not otherwise discuss how the body of water should be classified, nor did it indicate what difference it would have made if the bayou had been a running stream. Jackson v. Walton, 2 La. App. 53 (1925). The case is discussed more fully later, under *Natural Lakes and Bayous.*



Principal river basins of Louisiana.

article dealing with such rights refers only to "running water."[13] It i difficult to predict what bodies of water the court might consider to b subject to its terms. From the cases discussed below, it appears tha the court may require a flow more continuous than that which woul depend solely on rainwater, that the flow generally be only in one d rection, and that there be at least poorly defined banks. But none o these cases directly involved rights to use waters.

In 1904, the court said that a body of water which lay in th middle of a swamp, forming a part of a so-called shallow lake conveyin water sometimes one way, sometimes another, depending for its exis ence on overflow from streams or rainwater, was a mere slough rathe than a stream. This case involved the question of whether title to ce

---

[13] L.S.A.–Civil Code, Art. 661: "He whose estate borders on running wat may use it as it runs, for the purpose of watering his estate, or for other purpose

"He through whose estate water runs, whether it originates there or pass from lands above, may make use of it, while it runs over his lands; but he cann stop or give it another direction, and is bound to return it to its original channe where it leaves his estate."

The term "running water" is used also in Article 450, included in Appendix, infr tain lands was to be decided under the law applicable to rivers and streams, or under the law applicable to swamp and overflowed lands.[14]

In a 1957 case, the court was faced with the problem of determining whether a body of water called "the Deer Park Bend channel" was a "lake or pond" or a "river or stream" within the meaning of L.S.A.—Civil Code, Article 509.[15] This article deals with the ownership of "accretions" to soil formed along the shore of a "river or other stream."[16] The court stated broadly that this article applies to "all streams whose waters have the power to form accretions . . ." It noted that "Generally, a lake could not have so done because in it there is not sufficient moving water to form silt to the extent of forming additions to its banks."[17]

The court further concluded that:

> In the present case at the present time there is not a constant or continuous flow at low water around the bendway every day in every year, but definitely the bendway is not a lake. When it does flow it is not drainage and the bendway gets its water from the main body of the Mississippi River. A stream is not required to flow every minute of the time. In this case the bendway is characterized by definite banks on each side, a definite bed, a natural current always downstream with the main body of the Mississippi River being the source of water supply. The current is capable of carrying alluvion and of depositing it along the banks. These characteristics fulfill every possible requirement of a stream and prevent the Deer Park Bend channel from being classified as a lake or pond up to this time.[18]

With respect to the continuity of flow, the court noted that:

> Apparently the language of the article acknowledges that there is a distinction between a river and a stream. Smaller streams may

---

[14] Hall v. Board of Com'rs. of Bossier Levee Dist., 111 La. 913, 35 So. 976 (1904). See also State v. Aucoin, 206 La. 786, 20 So. 2d. 136 (1944) regarding the question of shallow lakes whose beds were granted to the state as "overflowed land" in swamp-land grants by Congress.

See *"Diffused Surface Water,"* infra, for a discussion of such water.

[15] Esso Standard Oil Co. v. Jones, 233 La. 915, 98 So. 2d. 236 (1957).

[16] L.S.A.—Civil Code, Art. 509: "The accretions, which are formed successively and imperceptibly to any soil situated on the shore of a *river or other stream,* are called alluvion.

"The alluvion belongs to the owner of the soil situated on the edge of the water, *whether it be a river or stream,* and whether the same be navigable or not, who is bound to leave public that portion of the bank which is required by law for the public use." (Emphasis added.)

[17] Quoting from Amerada Petroleum Corp. v. The State Mineral Board, 203 La. 473, 14 So. 2d. 61, 69 (1943), which is discussed later. It would seem, however, that accretions might form along the bank of a lake near the outlet of rivers or streams that may discharge into the lake.

[18] The ends of the horseshoe bendway had been cut across by the Corps of Engineers and the main channel of the river straightened.

This case involved the question of rights to oil royalties on oil taken from wells located on accretions of soil formed on the edge of the bendway.

The quoted statements are from the original trial court's opinion which the Supreme Court adopted as its own.

> go completely dry in the summer and resume their flow with the coming of winter rains. They must still retain their status as streams . . .

In 1943, the court similarly was faced with the problem of determining whether a body of water designated as an "Arm of Grand Lake" was in fact an arm of a lake, or whether it was a "river or other stream" falling within the scope of the above-mentioned Article 509. The court quoted extensively, with approval, from the trial judge's decision, which read in part as follows:

> According to these definitions[19] we must, therefore, note that a lake does not imply a body of water in which a current flows, but it indicates a body of water, more or less, stagnant, in which the water is supplied from drainage. In rainy seasons drainage would increase, and hence, the level of the water would probably rise and a current would form. A river is distinguished from a lake in that it flows, more or less, in a permanent bed or channel between defined banks or walls with a current, whereas streams are bodies of flowing water including rivers. A stream, therefore, includes any body of flowing water.
>
> We have seen that the arm of Grand Lake is a body of flowing water and in my opinion constitutes, therefore, a stream within the meaning of Article 509 of our Civil Code.
>
> It cannot be classified as a river, because it does not possess well defined banks or walls as are required of rivers, and it cannot be called a lake because its waters are not still or dead and the waters are not supplied from drainage as is required of lakes.[20]

The Supreme Court did not quarrel with these definitions set forth by the trial court. It noted that since the parties in the case had agreed that the water in question "flowed between banks," it might be a river.[2 But it concluded that, "Regardless of the characterization of the wate as a river or merely as a flowing stream, the conclusion reached by the trial judge is correct." Article 509 applies to both.[22]

The court noted also that the arm of Grand Lake was 3,960 and 4,400 feet wide, respectively, at the two points measured, and said:

> This width is relatively insignificant as compared to the width o Grand Lake, and this width between banks negatives the idea tha

---

[19] The trial judge had referred earlier to the definition of rivers, streams, an lakes as defined in *Black's Law Dictionary*. (Authors' footnote.)

[20] Amerada Petroleum Corp. v. State Mineral Board, 203 La. 473, 14 So. 2d. 6 68, 69 (1943).

[21] It also noted that the arm of Grand Lake "is unmistakably a part of Atchafalay River by which its waters are solely supplied." Amerada Petroleum Corp. v. Stat Mineral Board, 203 La. 473, 14 So. 2d 61, 70 (1943).

[22] Amerada Petroleum Corp. v. State Mineral Board, 203 La. 473, 14 So. 2d. 61, 7 (1943). Accord: Amerada Petroleum Corp. v. Case, 210 La. 630, 27 So. 2d. 431 (1946)

it is a lake instead of a widening branch or fork of the Atchafalaya River.[23]

It would appear, therefore, that the size of a body of water may be significant at least in distinguishing a lake from a mere widening of a stream or river for the purpose of deciding the applicability of Article 509 regarding accretions.

The court had earlier indicated in two cases that where rivers flowed through certain large bodies of water, these bodies of water were lakes and not merely widenings of the rivers.[24] The large size of the bodies of water in these two cases apparently was a factor in defining them as lakes rather than rivers or streams. They involved the question of whether the state had acquired title to lands adjoining a navigable lake that had become gradually covered by the lake waters. However, in the later of these two cases, the court indicated that a navigable lake would be treated the same as a navigable stream for this purpose,[25] overruling the former case in this regard. Under this view, the distinctions drawn between lakes and streams in these two cases apparently would not have been necessary.[26]

In the earlier of these two cases, the body of water involved was 18 miles long and from 4½ miles to 14 miles wide. The river entering the body of water was 600 feet or more in width and considerably deeper than the body of water. The river had a channel about 1,000 feet wide through this "lake," and in high water there was a slight current even near the shores of the lake. Under such a fact situation, the court conceded that in France, from which the Louisiana Code is largely taken, the lake would have been considered a mere widening of the river. But the court held that ". . . the better view . . . is to regard such a vast expanse of water as Calcasieu Lake as being in fact a lake, although a river empties into the sea through it."[27]

In the later case, the fact situation was nearly the same, except that the current in the lake was even stronger than in the earlier case. The court again treated the body of water, which was 3 to 9 miles wide and 10 miles long, as a lake rather than a stream.[28]

---

[23] The court also noted that the river's waters flowed "through it . . . to again form a distinct river . . . before reaching the gulf." Amerada Petroleum Corp. v. State Mineral Board, 203 La. 473, 14 So. 2d. 61, 70, 71 (1943). In the 1957 Esso case, supra, the width of the bendway was not given, nor was its size emphasized. In both cases, the court determined that riparian landowners were entitled to the accretions rather than the state, which had held title to the bed of the river.

[24] State v. Erwin, 173 La. 507, 138 So. 84, 86 (1931); Miami Corp. v. State, 186 La. 784, 173 So. 315, 319 (1936).

[25] Miami Corporation v. State, 186 La. 784, 173 So. 315, 322-323 (1936).

[26] In the Amerada case, supra (at 14 So. 2d. 61, 67, 68, 72), the court noted that these two previous cases did not deal with accretions and indicated that the decision in the later (Miami) case was based on articles of the Code and related legal principles dealing with public ownership of beds, and hence were not decisive of the above-described question faced in the Amerada case.

[27] State v. Erwin, 173 La. 507, 138 So. 84, 86 (1931).

[28] Miami Corporation v. State, 186 La. 784, 173 So. 315, 319 (1936).

In view of the two foregoing cases defining certain large bodies o water, although having some current, as lakes, it might be questione whether the courts would be willing to accept "any body of flowin water" (as stated in the above-mentioned 1943 case) as a definition o "a stream" in a case that would depend on such a definition.[29] It seem more likely that the court would be willing to distinguish between river and a stream on the basis of the existence or nonexistence of well defined banks, but would distinguish between a stream and a lake o other grounds than merely whether or not the water flowed. Thus, "stream" will probably be defined more liberally than a "river," bu not so liberally as to include "any body of flowing water."

The court has stated that a river or stream consists of its bed; it banks, and its water.[30] This would not preclude a distinction betwee a river and a stream; for, although both might be required to hav banks, a river *must* possess well-defined banks, while the banks of stream may be poorly defined.

Banks are defined in the Civil Code as follows:

> The banks of a river or stream are understood to be that whic contains it in its ordinary state of high water; for the nature of th banks does not change, although for some cause they may be overflowed for a time.
>
> Nevertheless, on the borders of the Mississippi and other navigable streams, where there are levees, established according t law, the levees shall form the banks.[31]

The court has extended this definition somewhat, so that:

> The land lying between the edge of the water at its ordinary lo stage and the line which the edge of the water reaches at its ordinary high stage—that is, the highest stage that it usually reache at any season of the year—is called the bank of the stream. . . .[32]

As the levees of navigable rivers are made the banks of the river by the Code article set forth above, it follows from the above definitio of banks that the levees are the ordinary high-water mark.[33] Becaus of the definition of banks, the bed of a stream is that land which i covered by water at its ordinary low stage.[34] But even though water i outside the bed of the stream, if it remains inside the levee or the ordinary high-water mark it would be within the watercourse.

---

[29] See in this connection 32 Tulane Law Rev. 319, 323, note 20 (1958).

[30] Morgan v. Livingston, 6 Mart. (O.S.) 19,229 (La. 1819); State v. Richardson 140 La. 329, 338, 72 So. 984 (1916).

[31] L.S.A.—Civil Code Art. 457.

[32] Wemple v. Eastham, 150 La. 247, 90 So. 637, 638 (1922) Accord: Seibert Conservation Commission, 181 La. 237, 159 So. 375, 377 (1935); Pizanie v. Gauthreaux 173 La. 737, 138 So. 650, 652 (1931); Ward v. Board of Levee Com'rs. of Orlean Levee Dist., 152 La. 158, 92 So. 769, 772 (1922).

[33] Seibert v. Conservation Commission, 181 La. 237, 159 So. 375, 377 (1935). Thi might not apply, however, in some cases where the levee may be located far beyon the ordinary high-water mark.

[34] Wemple v. Eastham, 150 La. 247, 90 So. 637 (1922); Pizanie v. Gauthreaux, 17 La. 737, 138 So. 650 (1932).

Nature of Riparian Rights

Unless otherwise indicated, we are concerned in this section only with rights concerning *nonnavigable* watercourses, saving for later the discussion of *navigable* watercourses.

The court has fairly recently defined riparian rights to be:

> The rights of owners of lands on the banks of watercourses relating to the water, its use, ownership of soil under the stream, accretions, etc.[35]

From an examination of this definition, it can be seen that two separate but interrelated points are involved in determining rights to watercourses. The first of these concerns *who* has such rights, and the second concerns *what* are the rights. The "who" is given by the definition quoted above to be "owners of lands on the banks of watercourses," and the "what" is given to be "the water, its use, ownership of soil under the stream, etc."

As a matter of definition, then, riparian rights are limited to those who own[36] lands on the banks of watercourses. This is not to say that persons not owning such lands might not have rights "relating to the water, its use, ownership of soil under the stream, etc.," but only that such rights are not defined (at least by the court and, therefore, this bulletin) to be *riparian* rights. In the following three subsections, which deal with ownership of beds, ownership of water, and rights to use water, we shall be thinking, then, only in terms of riparian rights, i.e., the rights of those owning lands *on the banks* of the watercourses.[37]

Ownership of Beds

It is now well settled by the Louisiana courts that the beds of nonnavigable streams which were nonnavigable in 1812[38] generally are owned by the riparian owners to the thread of the stream.[39] The threa is defined as "the line midway between the banks at the ordinary stag of water, without regard to channel or the lowest and deepest part o the stream."[40] (Under this rule, of course, one owning land on bot sides of a stream would own the entire bed.) The court has said tha this arises by inference from Articles 513, 514, and 515[41] of the Civi Code.[42] Apparently it is possible to transfer ownership of the bed separately from a transfer of the adjoining lands.[43] This possibility of separate ownership of the bed and adjoining land may well raise a problem for determining rights in and to the use of waters between th owner of the bed and the owner of the adjoining land. This is discussed later, under *Rights to Use Water.*

---

[35] Doiron v. O'Bryan, 218 La. 1069, 1081, 51 So. 2d. 628, 632 (1951). The dispute involved whether a conveyance of land that included "riparian rights" conveyed title to the bed of the adjoining water.

[36] In this bulletin, we shall, for convenience, use only the terms "own," "owner," and "ownership" when discussing the rights of persons in and to various waters. It is possible that persons holding or possessing land who are not the actual owners of the land may be entitled to claim, or be under a liability to observe, these rights. Thus a tenant or lessee may "stand in the shoes" of the owner, and be entitled to assert the same rights that the owner might have asserted. We therefore are using the above terms as "shorthand" symbols to describe all those persons, estates, and property interests that are capable of maintaining or defending an action based on the particular rights under discussion.

[37] Brief mention is made, however, of the possibility of ownership of beds by nonriparian landowners. The possibility of water use by nonriparian landowners is discussed later, under *Nonriparian Use.*

[38] The date of Louisiana's admission as a state into the United States. See 2 Stat. 701, effective April 30, 1812.

The beds of nonnavigable streams which were navigable in 181 however, may be owned by the state[44] (although the state could hav transferred ownership of the bed of a formerly navigable stream to private individuals after it became nonnavigable).[45]

---

[39] Begnaud v. Grubb and Hawkins, 209 La. 826, 25 So. 2d. 606 (1946); Amit Gravel and Sand Co. v. Roseland Gravel Co., 148 La. 704, 707, 87 So. 718, 719 (1921) Wemple v. Eastham, 150 La. 247, 253, 90 So. 637, 638 (1922); Nattin v. Glassell, 15 La. 423, 426, 100 So. 609 (1924); Bodcaw Lumber Co. of Louisiana v. Kendall, 16 La. 337, 338, 108 So. 664 (1926).

[40] State v. Burton, 106 La. 732, 31 So. 291, 292 (1902).

[41] L.S.A.—Civil Code, Art. 513: "Islands and sand bars which are formed i streams not navigable, belong to the riparian proprietors, and are divided amon them according to the rules prescribed in the following articles."

L.S.A.—Civil Code, Art. 514: "If the island be formed in the middle of th stream, it belongs to the riparian proprietors, whose lands are situated on th sides opposite the island. If they wish to divide it, it must be divided by a lin supposed to be drawn along the middle of the river. The riparian proprietors the severally take the portion of the island which is opposite their land, in proportio to the front they respectively have on the stream opposite the island."

L.S.A.—Civil Code, Art. 515: "If on the contrary, the island lies on one of th sides of the line thus supposed to be drawn, it belongs to the riparian proprietors the side on which the island is, and must be divided among them in proportion to th front they respectively have on the stream opposite the island."

[42] Begnaud v. Grubb and Hawkins, 209 La. 826, 25 So. 2d. 606, 609, 610 (1946).

[43] Nattin v. Glassell, 156 La. 423, 426, 100 So. 609 (1924). In this case, the ownership of the bed of the nonnavigable stream was not actually in dispute, and th court did not decide where the title lay. It did, however, find that the words in deed indicated that ownership of certain land was to be determined by measurin from the *banks* of the stream rather than the thread, saying, that in a sale of riparia land, ". . . the ownership extends to the thread, *unless it clearly appears otherwis that a different purpose was intended.*" (Emphasis added.)

[44] Wemple v. Eastham, 150 La. 247, 90 So. 637 (1922); Smith v. Dixie Oil Co 156 La. 691, 702, 101 So. 24 (1924). Also see L.S.A.—R.S. 9:1101 as amended, Ac 1954, No. 443 whereby the Legislature declared the state to be the owner of a river and stream beds which were not privately owned on August 12, 1910. This discussed under *Navigable Watercourses: Ownership of Beds,* infra.

[45] Bd. of Com'rs. of Caddo Levee Dist. of Louisiana v. Glassell, 120 La. 400, 45 S 370 (1907). See La. Op. Atty. Gen. 1938-40, p. 705, for an opinion that after navigable stream becomes nonnavigable the state owns the bed as a private, n

Ownership of Water

It appears that the waters flowing in rivers and streams, whether navigable or nonnavigable, are incapable of being privately owned.

L.S.A.–Civil Code, Article 450 cites running water as an example of a "common thing," the ownership of which belongs to nobody in particular,[46] and Article 482 states that common things are not susceptible of ownership.

In 1910 the Legislature declared the waters of "bayous, lagoons, lakes, and bays . . . not under the direct ownership of any person" to be the property of the state,[47] and in 1954 amended this declaration to include the waters of "rivers" and "streams,"[48] apparently not being satisfied that the former terms were sufficiently broad to cover rivers and streams. This declaration, as amended, reads as follows:[49]

> The waters of and in all bayous, rivers, streams, lagoons, lakes, and bays, and the beds thereof, not under the direct ownership of any person on August 12, 1910, are declared to be the property of the state. . . .
>
> This Section is not intended to interfere with the acquisition in good faith of any waters or the beds thereof transferred by the state or its agencies prior to August 12, 1910.

It will be noticed that the statute exempts from state ownership any waters which were privately owned on August 12, 1910. This exception would not seem to be applicable to the waters of rivers and streams, for, by the terms of L.S.A.–Civil Code, Article 450 (supra)—which has remained basically the same since the admission of Louisiana into the United States—running water is not susceptible of private ownership. The implication of the exception that such water might have been privately owned results from the inclusion of running waters with other waters which *are* susceptible of private ownership.[50] The excepting clause is meaningful when read in connection with the entire sentence.

---

[45] (*Continued*)
public, property of the state, and hence may "prevent the public from using the stream for any purpose."

It also may be noted that a recent Supreme Court decision indicates that if the state had transferred title to navigable river beds prior to a 1921 constitutional provision (see below) to individuals, the individuals retain good title to the beds. California Co. v. Price, 225 La. 706, 74 So. 2d. 1 (1954).

L.S.A.–Const. Art. 4, sec. 2 (1921) contains a provision prohibiting the alienation of the beds of navigable streams by the state. Prior constitutions had no such provisions. See *Navigable Watercourses: Ownership of Beds,* infra.

[46] L.S.A.–Civil Code, Art. 450: "Things which are common, are those the ownership of which belongs to nobody in particular, and which all men may freely use, conformably with the use for which nature has intended them; such as air, *running water,* the sea and its shores." (Emphasis added.)

[47] La. Acts 1910, No. 258.

[48] La. Acts 1954, No. 443.

[49] L.S.A.–R.S. 9:1101. The entire section is included in Appendix, infra.

[50] See *Natural Lakes and Bayous,* infra.

Right to Use Water

Although the state apparently owns the water flowing in rivers an streams within its borders, the riparian owners have certain rights i and to the use of these waters. Article 661 of the Civil Code sets fort the riparian doctrine in Louisiana. It reads as follows:

> He whose estate borders on running water may use it as it run for the purpose of watering his estate, or for other purposes.
>
> He through whose estate water runs, whether it originates ther or passes from lands above, may make use of it, while it runs ove his lands; but he cannot stop or give it another direction, an is bound to return it to its original channel, where it leaves hi estate.

(A similar provision was included in the Civil Code of 1808, whic evidently was borrowed from a provision in the Code Napoleon, 1804.[51]

In 1917 the court indicated that this Article vested certain rights i riparian owners, saying:

> Rural estates have always been bought and sold here with reference to the streams that furnish their water supply, and to th law which declares that he whose estate borders on running wate

---

[51] This provision has undergone a few modifications since its incorporation in th Civil Code of 1808, which was in force in the territory prior to the state's admissio to the Union in 1812. In the 1808 Code, p. 128, Art. 8, it read as follows:

"He whose estate borders on running water, may use it as it runs, for the purpos of watering his estate."

"He through whose estate this water runs, may make use of it in the spac which it runs over, but he is bound to return it to its ordinary channel whe it leaves his estate."

This provision was identical with Art. 644 of the Code Napoleon, 1804, excep that in the Code Napoleon the following words were added in the first paragraph "other than that which is declared to belong to the public domain by article 538 under the title *of the Classification of Property. . . ."* See *Navigable Watercourses Right to Use Water,* infra.

(It may be noted that the Louisiana Code of 1808, p. 128, Art. 5, provided that "He who has a spring upon his estate, may use it as he pleases, saving the righ which the proprietor below may have acquired by title or by prescription." Art. provided that a prescriptive right might be acquired by a lower proprietor after 3 years uninterrupted enjoyment following completion of works to facilitate the fall c and course of water through his estate. Art. 7 provided that: "The proprietor o the spring cannot change its course when this spring supplies the water that is nec essary to the inhabitants of a city or town. But if the inhabitants have not acquire the use of said spring by prescription or otherwise, the proprietor may claim compensation for this use." However, these provisions, which were based on th Code Napoleon, were omitted from the 1825 and later Louisiana codes. The redacto of the 1825 Code noted that: "We have thought it best to suppress these thre articles by which it was permitted to the owner who has a spring on his estate, ma dispose of its waters under certain modifications at his pleasure [sic]. We hav thought it was for the public interest to establish, as we have done in the following article, that the owner shall be bound to keep the water in its ordinary cours at the place where it leaves his estate, whether the spring be on his land, or whethe the water comes from above his own." The article adopted was a modification o Art. 8 of the 1804 Code and a forerunner of Art. 661 of the Code of 1870. *Louisian Legal Archives* (1937), Vol. 1, p. 71, and Vol. 3, pp. 1983-1984.)

Who has the right to use this water, and for what purposes?

> or through whose estate water runs, may use it as it runs (Civil Code, Art. 661), . . . and [this provision has] been read into the titles to all the lands bordering upon all the streams, and through which streams have run, in this territory, since and before the State was created, and [has] vested in the owners of such lands the rights to which [it refers].[52]

Riparian owners also may have certain rights to use the waters of nonnavigable streams by virtue of the fact that they generally own the beds. Article 505 of the Civil Code states that: "The ownership of the soil carries with it the ownership of all that is directly above or under it." At first glance, this would seem to indicate that the owner of the bed would own the water above it, but we have seen that running water is incapable of private ownership.[53] This Article cannot, then, give absolute ownership of the water to the riparian owners. But it is possible that certain rights to the water may be given by it.[54]

---

[52] Palmer Co. v. Wilkinson, 141 La. 874, 75 So. 806, 810 (1917). The case involved an action by the owner of riparian land along a nonnavigable stream called Coushatta Bayou to enjoin the defendant from exercising alleged mineral rights to drill for oil or gas in the bed of the stream under a lease from the state. The riparian landowner claimed that he owned the bed in question or, in any event, was entitled to have the water "free and unpolluted." The court held that he had stated a cause of action. The court also indicated, however (at 75 So. 810), that ". . . the state, in the exercise of its police powers, and in the public interest, may, perhaps, maintain a certain control, or take certain action, the extent and circumstances of which we shall not here attempt to define . . ." citing two earlier cases involving drainage and improvements for navigation. See also cases cited under L.S.A.—Const. (1921), Art. 4, sec. 15, Notes of Decisions, No. 33, with respect to vested rights and the exercise of the state's police power.

[53] See *Ownership of Water,* supra.

We shall now proceed to consider the nature and extent of the rights of the owners of riparian land along a flowing stream or other natural watercourse, as between each other, to use the water in connection with this riparian land. (The questions of what constitutes riparian land and of using water on nonriparian land are considered later.) There appear to be very few clear answers here. We shall, however, examine certain uses that may be made of water, and certain limitations on its use, so as to provide some indication of the rights involved. In the following discussion, we shall examine certain water uses from the standpoint of general riparian rights, with a consideration of legislative changes and programs left for later.

Irrigation—L.S.A.—Civil Code, Article 661 states that a riparian owner may use running water "as it runs, for the purpose of watering his estate. . . ." This certainly provides for some irrigation by the riparian owner, but just how much is not clear.

It may be noted that Article 661 also states that one through whose estate water runs ". . . cannot stop or give it another direction, and is bound to return it to its original channel, where it leaves his estate,"[55] while a section of the Revised Statutes provides that: "No person diverting . . . the course of water from a natural drain shall fail to return the water to its natural course before it leaves his estate without any *undue retardation* of the flow of water outside his enclosure thereby injuring an adjacent estate."[56] (Emphasis added.) But it is not very

---

[54] A somewhat similar situation exists in the case of oil and gas beneath the surface of the earth. The court has held that these minerals, like running water, are insusceptible of private ownership, while beneath the surface of the earth and "in place." Continental Securities Corporation v. Wetherbee, 187 La. 773, 175 So. 571 (1937). Nevertheless, the owners of the overlying soil have the right to reduce them to possession and make them their personal property. Allies Oil Co. v. Ayers, 152 La 19, 92 So. 720 (1922); Continental Securities Corp. v. Wetherbee, 187 La. 773, 175 So. 571 (1937). Under such reasoning, the riparian owners, who are for the most part the owners of the beds of nonnavigable streams, would have the right to reduce these waters to possession and make them personal property.

One major distinction which must be noted between the two situations, however (besides the obvious fact that running water lies above the surface and oil and gas beneath the surface) is that in the case of running water the state has declared itself to be the owner (see *Ownership of Beds*, supra), while it has made no such pronouncement concerning oil and gas. Nevertheless, since any rights granted under L.S.A.—Civil Code, Article 505 would have been granted for more than 100 year prior to the state's pronouncement of ownership, it seems possible that ownership of the bed may carry with it some rights in the water above it.

A possible difficulty which should be noted if this approach concerning ownership of beds and the right to use water is valid is the problem created if ownership o the bed may be in a different person than ownership of the banks. (See *Ownership o Beds*, supra.) L.S.A.—Civil Code, Art. 661 clearly gives certain rights to use the water to owners of the banks. If L.S.A. Civil Code, Art. 505 gives these same rights to the owners of the beds, a direct conflict between the two articles might result.

[55] See L.S.A.—Civil Code, Art. 661 in Appendix, infra.

[56] L.S.A.—R.S. 38:2:18.

Siphoning water for irrigation.

clear as to what constitutes such diversion. The significance of these provisions is discussed later, under *Diversion*.

In a 1926 case before the Louisiana 2d Circuit Court of Appeal, Article 661 was invoked by a lower owner in an attempt to compel the upper owner to remove two terraces which diverted water away from a natural drain into other drains located on the lower lands. It was contended that this caused flooding of the lower lands. Apparently the drain was not a continuous stream running from the upper estate onto the lower estate, and Article 661 was probably not applicable. But the court said that even if it conceded that it was applicable:

> It [Article 661] must be construed with the preceding article[57] and with the rule of construction which has been universally followed by the Supreme Court of this State in its application of the law to cases where one of the owners of contiguous estate has constructed works for improving and cultivating his land.
>
> The universal rule in this State has been to construe the law so as to reconcile it with the interests of agriculture; . . .[58]

---

[57] L.S.A.—Civil Code, Art. 660. See Appendix, infra. (Authors' footnote.)

[58] Chandler v. Scogin, 5 La. App. 484 (1926).

It may be noted that p. 128, Art. 9, of the Civil Code of 1808 contained a suggestion that in disputes concerning waters the judges should "conciliate the interest of agriculture with the respect due to property." However, this was deleted in the Code of 1825. The notes of the redactors indicate that this was done because the provision contained "rather advice than commands." *Project of the Civil Code of 1825, 1 Louisiana Legal Archives* 71 (1937).

In an earlier case (in 1885), where rights concerning waters in a constructed canal and cross ditch were involved, the Supreme Court indicated that while rights concerning the canal grew out of contractual agreements, these agreements did not contradict, and were supplemented by, Article 661 and certain other Code articles. The agreements related to the use of a canal that led from a lake or swamp across one sugar plantation to another adjoining plantation. This canal was crossed at right angles by a cross ditch on the former plantation. The court said that the owner of the former plantation could use the cross ditch for the proper cultivation and development of his estate, provided he did not thereby "unnecessarily divert" the flow in the canal or cause any "permanent injury" to the adjoining landowner which might seriously impair his contractual right to draw water through it, citing Article 661.[59]

These two cases appear to indicate that Article 661 is to be construed in cases involving rights to use water for irrigation so as to reconcile it with the interests of agriculture. This would be consistent with the way in which the preceding article (660), which deals with drainage rights, has been construed.[60] If this construction is placed on Article 661, it would seem that some form of a "reasonable use" rule would be developed within the framework of the riparian doctrine. The best interests of agriculture conceivably might be furthered by the application of some other doctrine, such as the Western "prior appropriation doctrine," but since Article 661 apparently is a statement of the riparian doctrine, it would seem more likely that it will continue to be applied.[61]

Probably, then, the right to use water for irrigation from nonnavigable streams is granted to the riparian owners; and the water is to be distributed among them (at least for irrigation purposes) such that each owner might use the amount of water that is "reasonable" under the particular circumstances.

There may, of course, be conflicts in the use of water between opposite owners on a stream, as well as between upper and lower owners. In view of the fact that each owner would be allowed to "water his estate," it would seem that some form of a "reasonable" distribution of water between the two would be called for. Each estate would have a right against and a duty to the other estate under Article 661, and it would seem that such a distribution would very likely arise in a situation of this kind.

---

[59] His principal use of the water was for operating his sugarhouse. Shaffer v. State National Bank, 37 La. Ann. 242, 248 (1885). Other questions involved in this case are discussed under *Dams and Obstructions* and *Artificial Watercourses,* infra.

[60] Martin v. Jett, 12 La. 501, 32 Am. Dec. 120 (1838); Guesnard v. Bird's Exr's., 33 La. Ann. 796 (1881); Ludeling v. Stubbs, 34 La. Ann. 935 (1881); Petit Anse Coteau Drainage Dist. v. Iberia & V.R. Co., 124 La. 502, 50 So. 512 (1909); Broussard v. Cormier, 154 La. 880, 98 So. 403 (1923); Bolinger v. Murray, 18 La. App. 158, 137 So. 761 (1931); Becknell v. Weindhal, 7 La. Ann. 291, 292 (1852).

[61] This would be in accord with the usual French interpretation of Article 644 of the Code Napoleon (1804), according to Wiel, S. C., "Waters: American Law and French Authority," 33 Harvard Law. Rev. 133, 134, 148 (1919).

Contractual Agreements—Particularly since the Louisiana law on the above and several other questions is not settled, consideration might be given to the possibility of entering into voluntary contractual arrangements.

L.S.A.—Civil Code, Article 752 provides that ". . . servitudes . . . which result from the situation of places, may be altered by the agreement of the parties, provided the public interest does not suffer thereby." This would seem to permit alternation of the riparian servitude under Article 661 of the Code as between upper and lower, or opposite, landowners.[62]

Apparently, a contract could be entered into by two or more riparian landowners located on the same stream to rotate or otherwise regulate the use of its waters, as between the contracting parties and between themselves and other riparian owners of the state or public. For example, by rotating their use during periods of short supply, the contracting parties would not reduce the streamflow as much as they might do otherwise.

The effectiveness of such contracts in reducing the danger of being enjoined by, or having to pay damages to, others who have not joined therein may be enhanced if the Louisiana courts adhere to a rule of reasonable use, as discussed above.[63]

Domestic and Other Uses—The right to use water from nonnavigable rivers and streams for domestic purposes has never been clearly determined by the court, but no doubt riparian owners have such a right.[64] Recall that L.S.A.—Civil Code, Article 661, discussed above, mentions use for watering a riparian owner's estate *or for other purposes.* So long as the level of a stream is not appreciably diminished by the use for domestic purposes, the use would appear to be authorized by this article. Where, however, the stream would be diminished to the extent that lower owners might be deprived of the streamflow, it is difficult to determine how the water would be allocated—the upper riparian owners might be granted the entire flow of the stream, or there might be some equitable division of the flow among all the riparian owners. Probably the court would follow the French lead and apply some form of the "reasonable use" doctrine, such that all owners would share in the streamflow.[65]

---

[62] It should be noted, however, that with respect to the servitude of drainage as between upper and lower lands under Article 660 of the Code (see Appendix, infra.), an appellate court has held that while such servitudes may be altered by agreement between the parties, by virtue of Article 752, of the Code, such a servitude affecting real estate cannot be altered in such a way as to hold subsequent owners of either property unless the agreement is in writing and is put on record or unless the subsequent proprietors can be charged with knowledge of the written agreement in some form or manner. Cornett v. Hebert, 31 So. 2d. 446, 450 (La. App., First Circuit, 1947).

Also see notes 148 and 150, infra., regarding the execution of access agreements and contracts with nonriparian owners.

[63] Their effectiveness would also be enhanced by adherence to "the balance of convenience" rule, discussed under *"Pollution,"* infra.

[64] See Palmer Co. v. Wilkinson, 141 La. 874, 75 So. 806, 810 (1917). The court apparently has not defined domestic uses other than by its reference in a case dealing with a navigable river to ". . . domestic purposes, *ad lavandum et potendum* . . ." The qualifying words apparently mean "to wash and to drink." New Orleans Waterworks Co. v. Louisiana Sugar Refining Co. and City of New Orleans, 35 La. Ann. 1111 (1883). The case is discussed later, under *"Navigable Watercourses: Right to Use Water."* See also the definition of domestic use in the Sabine River Compact, discussed later. What influence, if any, this definition might have on the Louisiana courts, except with respect to the Compact, is problematical.

The right to fish in nonnavigable streams apparently is vested solely in the riparian owners. In 1906, the court held that an injunction should not be issued compelling a riparian owner of lands on both sides and presumably the beds of certain nonnavigable bayous and lagoons to allow a fisherman who apparently was not a riparian owner to use these waters within the riparian owner's lands.[66]

Pollution—There have been a great many pollution cases in the last 50 years. It has not always been clear, however, under just what legal theory the courts have decided some of the cases.

The authors have been unable to discover any reported court decision in Louisiana where damages have been refused to an injured riparian owner on the grounds that the upper riparian had a right to cause the injurious pollution. There has been language in some cases indicating that a reasonable pollution might be made,[67] that pollution, if not negligent, might be allowed,[68] and there have been holdings that the right to recover damages had been lost by failing to take timely action,[69] or because damages were not proved.[70] But there have been no holdings denying recovery where, in fact, a timely claim has been made and actual damages shown. It seems likely that a riparian owner has a right to pollute a stream as against other riparian owners, only so long as they are not injured.[71]

---

[65] See Weil, S. C., "Origin and Comparative Development of the Law of Watercourses in the Common Law and in the Civil Law," 6 Calif. Law Rev. 245, 263 (1918) and Weil, op. cit., note 61, 33 Harvard Law Review, pp. 149-151.

[66] Burns v. Crescent Gun and Rod Club, 116 La. 1038, 41 So. 249 (1906). The Louisiana Attorney General also has rendered an opinion to the same general effect. Report and Opinions of the Attorney General, 1938-1940, p. 705. See also Louisiana Navigation Co. v. Oyster Commission, 125 La. 740, 51 So. 706, 712 (1910); Delta Duck Club v. Barrios, 135 La. 357 and 364, 65 So. 489 and 491 (1914).

[67] Long v. Louisiana Creosoting Co., 137 La. 861, 69 So. 281 (1915); Orten v. Virginia-Carolina Chemical Co., 142 La. 790, 77 So. 632 (1918); Barrow v. Gaillardine, 122 La. 558, 47 So. 891 (1908).

[68] Phillips Petroleum Co. v. Hardee, 189 F. 2d. 205, 212 (1951).

[69] Young v. International Paper Co., 179 La. 803, 155 So. 231 (1934).

[70] Ricou v. International Paper Co., 117 F. Supp. 128 (1953); Rhodes v. International Paper Co., 174 La. 49, 139 So. 755 (1932).

[71] These observations are limited to actions between private riparian owners. The rights and liabilities of riparian owners to pollute streams as against public and state rights are discussed later, under *Pollution Control by Public.*

The same rule does not apply, however, regarding the right of a riparian owner to injunctive relief from upstream pollution. Even though damages are allowed the lower owner, he may not be able to prevent the polluter from continuing the pollution. Here the "balance of convenience" rule is applied, such that the relative good done by the pollution is weighed against the harm done, the cost of a cessation of the pollution is weighed against the advantage of a cessation, the good faith and exercise of care by the polluter is taken into account, the best interests of the community are considered, and, in general, the relative "conveniences" of the parties are balanced.[72] And, also, if actual or imminent damages are not shown, the injunction will be denied.[73]

Thus, a form of "reasonable use" is applied to test the availability of injunctive relief, even though a "strict liability" test is apparently applied for the determination of money damages.

We shall now consider in more detail the reported court decisions regarding a riparian landowner's right to damages as against a polluter.

In a 1915 case in which a lower riparian owner's land was injured by the negligent pollution of a stream by an upper riparian owner, the court talked in terms of "reasonable use." In the trial court, the lower riparian owner had been granted $200 damages for the injury to his land, and the upper owner appealed. The Supreme Court affirmed this decision, saying that although the right of a lower riparian owner to receive the waters from above in a pure state was subject to the right of upper riparian owners to make a reasonable use of the stream, the question of reasonableness of the pollution ". . . is for the judge or jury to determine from all the circumstances of a case, including the nature of the watercourse, its adaptability for particular purposes, the extent of injury caused to the lower riparian owner, etc."[74]

The court apparently was thinking in terms of the reasonable use doctrine found in several eastern common law states. (It cited no Civil Code article.) But the case has been neither cited nor followed in any pollution case considered later. It stands as the only case in which it appears that damages were determined by the relative rights of riparian owners to utilize the water, rather than by considering the duty of one owner not to cause injury to the property of another owner.

Just three years later, in 1918, the court, when faced with a case in which a chemical company had permitted sulphuric acid to escape into a drain emptying into a bayou running through a lower riparian owner's lands such that vegetation and livestock were killed, attacked the problem on the theory that such a use of property created a nuisance. This approach resulted in a form of reasonable use test again being applied, the court quoting from 29 Cyc. 1156:

---

[72] Young v. International Paper Co., 179 La. 803, 155 So. 231 (1934); Ricou v. International Paper Co., 117 F. Supp. 128 (1953); Clark v. Gifford-Hill Co., Inc., 100 F. Supp. 879 (1951); Maddox v. International Paper Co., 47 F. Supp. 829 (1943).

[73] Young v. International Paper Co., and Ricou v. International Paper Co., supra.

[74] Long v. Louisiana Cresoting Co., 137 La. 861, 69 So. 281, 282 (1915).

> A fair test as to whether a business lawful in itself, or a particular use of property, constitutes a nuisance is the reasonableness or unreasonableness of conducting the business or making the use of the property complained of in the particular locality and in the manner and under the circumstances of the case, and where the use made of his property by the person complained of is not unreasonable, it will not, as a rule, be enjoined, nor can a person complaining thereof recover damages. But when it is established that a person is creating a nuisance, the mere fact that he is doing what is reasonable from his point of view constitutes no defense.[75]

The lower owner was allowed damages for the injury sustained. Although the court also applied a "reasonableness" test in this case, it should be noted that recovery was allowed because the upper riparian owner had used his property in such an unreasonable way as to create a nuisance. But so long as the same criteria used to determine reasonableness under a theory of nuisance are applied to the determination of the reasonableness of pollution under the theory of riparian rights, there would seem to be little difference in effect between the two approaches. Whether it is determined that a certain pollution is unreasonable and hence a nuisance violating the lower owner's right to enjoyment of his property, or it is determined that the pollution is unreasonable and hence a violation of his rights to the flow of the stream will make little difference if the same factors are taken into account in determining the reasonableness of the pollution.

The court had taken a third approach in an earlier case (1907) where an upper riparian owner had polluted a stream with salt water. The polluter attempted to avoid liability on the basis of L.S.A.–Civil Code, Article 660, which reads as follows:

> It is a servitude due by the estate situated below to receive the waters which run naturally from the estate situated above, provided the industry of man has not been used to create that servitude.
>
> The proprietor below is not at liberty to raise any dam, or to make any other work, to prevent this running of water.
>
> The proprietor above can do nothing whereby the natural servitude due by the estate below may be rendered more burdensome.

The polluter argued that this required the lower owner to receive the stream as it flowed from the polluter's estate, but the court held that this requirement, by the terms of the article, applied only to waters that ran "naturally" and were not rendered more burdensome by the upper riparian polluter. The taking of salt water from beneath the earth and placing it in the stream had rendered the servitude more burdensome through the industry of man, and the waters were not running naturally from the upper estate. Thus the polluter was liable for damages for the injury caused.[76]

---

[75] Orton v. Virginia-Carolina Chemical Co., 142 La. 790, 77 So. 632, (1918).

This opinion was relied upon by a Federal District Court of Louisiana in deciding a 1943 case in which waste water was periodically released by the upper riparian owner (defendant) into a stream such that fish were killed and the water of the stream blackened. The lower owner (plaintiff) owned a fishing camp on the stream for commercial and sport fishing which was ruined by defendant's polluting of the stream. The defendant was not in any sense negligent, but, rather, had exercised good faith and great care to prevent harmful pollution. Plaintiff sought damages and to enjoin defendant from further polluting the stream.

The defendant argued, as one point of his case, that the injury was "damnum absque injuria"; i.e., that though the plantiff had been injured, the injury was not compensable at law under L.S.A.–Civil Code, Article 2315, under which the plaintiff was bringing his action. The pertinent sentence of this statute reads: "Every act whatever of man that causes damage to another, obliges him by whose fault it happened to repair it; . . ."[77] The court held, however, that Article 660 of the Code prevented the injury from being "damnum absque injuria," and the case clearly fell within the broad principle of Article 2315. The fact that the defendant had acted in good faith and with great care did not constitute a defense to an award of damages to the plaintiff.[78]

This third approach, using Article 660 as its basis, would indicate that any pollution rendering the lower estate's servitude to receive water more burdensome would give a cause of action to the lower estate. In practice, this approach could be reconciled with a reasonable use theory by construing Article 660 liberally to allow a reasonable amount of pollution, but there is no indication that this will be done. It seems that any pollution causing injury to a lower estate furnishes a cause of action.

The question of negligence or fault on the part of the polluter is difficult to unravel from the holdings and language of the decided cases. Under Article 2315 of the Code, any act causing damage to a person ". . . obliges him by whose fault it happened to repair it; . . ." Two defenses which might be set up by an upstream polluter to escape liability for injuries caused to downstream owners by his act of pollution are (1) that his act was done with care and good faith and hence is not caused by "fault" under the article, and (2) that he either has a right to use the stream as he has, or that the lower owner has no legal right to the pure flow of the stream, and hence the "act" is outside the scope of the article.

---

[76] McFarlain v. Jennings-Heywood Oil Syndicate, 118 La. 537, 43 So. 155 (1907). Also see Barrow v. Gaillardine, 122 La. 558, 47 So. 891 (1908) where the court held that the owner of an upper estate could not allow sugarhouse slops to drain into a bayou under authority of L.S.A.–Civil Code, Article 660.

[77] This is the general provision of the Civil Code regarding civil wrongdoings (called *torts*).

[78] Maddox v. International Paper Co., 47 F. Supp. 829, 831 (1943).

In the 1915 "reasonable use" case and the 1918 "nuisance" case, the court apparently accepted the second defense as valid, even though in both cases the particular facts prevented it from operating. The 1907 case and the 1951 Federal court case would deny the validity of the second defense, on the grounds that Article 660 of the Code sets up a legal duty compelling the upper riparian not to further burden the servitude due by the lower estate by polluting the stream. The Federal court case also denied the validity of the first defense, although no grounds were assigned for the denial.

The first defense, hinging on the issue of "fault," apparently is of no avail so long as there is a duty owed by the riparian owner to the lower owners not to pollute a stream to the extent that injury is caused the lower owners. It is here that the court's interpretation of Article 660 seems incompatible with its language concerning "reasonableness." It seems that Article 660 creates a duty not to make the servitude more burdensome, while in certain circumstances, a reasonableness test would of necessity allow the upper owner to make the servitude more burdensome.

It seems that Article 660 has won out, for the more recent pollution cases appear to have established that the downstream riparian owner can recover when he can prove damages and show that the actions of the polluter caused these damages.[79] The only possible exception to this rule that the writers have discovered is the case of *Phillips Petroleum Co. v. Hardee,* in which a United States Court of Appeals indicated that negligence on the part of the polluter must be shown.[80] But as the point, which the court was called upon to decide, concerned an interpretation of the Louisiana law applicable to the liability of joint wrongdoers, perhaps a great deal of weight should not be attached to this, particularly in view of the holdings by the Louisiana courts allowing damages even when great care has been shown.

Diversion—"Diversion" as used here means the changing of the course of a stream, either wholly or partially from its natural course into a different channel. L.S.A.—Civil Code, Article 661 provides that: "He through whose estate water runs . . . may make use of it while it runs over his lands; but he cannot stop or give it another direction, and is bound to return it to its original channel, where it leaves his estate.[81] This statement is somewhat ambiguous, for the prohibition against giving water another direction would seem to prohibit diversion while the mandate to return the water to its "original channel" seems to imply that it might be taken from its natural channel for a time. Perhaps, however, the implication is only that water might be *withdrawn* from the stream, rather than that the course of the stream might be changed; thus authorizing withdrawal and not diversion. Or perhaps what is meant is that the entire flow cannot be given another direction, or diverted, but that a partial diversion would be allowed so long as a certain flow is left in the original channel, and the diverted water is returned to the channel.

---

[79] Williams v. Pelican Natural Gas Co., 187 La. 462, 175 So. 28 (1937); Greer v. Pelican Natural Gas Co., 163 So. 431 (La. App. 1935); Bilbray v. Pelican Natural Gas Co., 163 So. 433 (La. App. 1935); Young v. International Paper Co., 179 La. 803, 155 So. 231 (1934); Rhodes v. International Paper Co., 174 La. 49, 139 So. 755 (1932); Ricou v. International Paper Co., 117 F. Supp. 128 (1953); Connell v. International Paper Co., 99 F. Supp. 699 (1951); Clark v. Gifford-Hill Co., 100 F. Supp. 879 (1951); Busby v. International Paper Co., 86 F. Supp. 603 (1949); Maddox v. International Paper Co., 47 F. Supp. 829 (1943); White v. Edgerly Petroleum Co., 4 La. App. 20 (1925).

[80] 189 F. 2d. 205, 212 (1951).

In any case, the Legislature has indicated that diversion under certain circumstances will be allowed by the following statute:

"No person diverting . . . the course of water from a natural drain shall fail to return the water to its natural course before it leaves his estate without any undue retardation of the flow of water outside his enclosure thereby injuring an adjacent estate." Penalty is provided for violation.[82]

It is not clear what the courts might hold in a situation in which a stream is diverted for purposes of water use rather than drainage. It would seem that if the diverter returns the stream to its original channel where it leaves his estate, without undue retardation, the diversion would be allowed, as probably the lower owner would not ordinarily be injured. At the other extreme, if the diverter changes the course of the entire stream so that it flows from his estate onto the lands of a person different from the one who would have received the waters in their natural course, it would seem that the owner deprived of the waters might complain of this deprivation. Whether he would have to show actual or impending damage to maintain a cause of action is difficult to determine, but it would seem from the Civil Code that he would be entitled to the flow as a servitude,[83] and should not be required to show damages.

Between the two extremes of diversion lie the situation in which the upper owner might divert a portion of the stream, allowing the rest to flow in its natural channel; and that in which he diverts the waters onto lands owned by the same person who would have received the stream in its natural channel, but not at the point at which they would enter naturally. Prediction of the legal results of such actions would be difficult to make with any assurance of accuracy. But there is some indication from an 1885 court decision,[84] discussed above under *Irrigation*, that some kind of reasonable use rule may apply at least in the former type of case.

---

[81] This article provides also that "He whose estate borders on running water may use it as it runs, for the purpose of watering his estate, or for other purposes." See Appendix, infra.

[82] L.S.A.–R.S. 38:218. This section provides for a fine of $25 to $100 and/or imprisonment for 10 to 30 days.

[83] See *Nature of Riparian Rights: Right to Use Water,* supra.

The above discussion has dealt with diversion of waters by an owner *through* whose lands the stream runs. In such a situation, there are no rights of an opposite owner to consider. When a riparian owner diverts water from a *bordering* stream, such that an opposite owner is affected, a different situation is presented. For even though all the water diverted is returned farther downstream, the opposite owner may be adversely affected. There is little on which to base an opinion as to the relative rights of the riparian owners in such a case. Article 661 of the Code would seem to indicate that a complete diversion of a stream by one owner would violate the servitude due the opposite owner created by the Article. Perhaps a partial diversion of the stream would be allowed, particularly if the "interests of agriculture" would be served by such diversion. A great deal would depend upon how strictly the court would interpret the servitude of Article 661. It seems probable that some form of reasonableness test would be applied in situations such as that indicated earlier under the discussion of *Irrigation*.[85]

Dams and Obstructions—There have been a number of decided cases in which the lower owner has obstructed a stream in such a way that the upper owners are damaged by the waters that are backed up or by the lack of proper drainage.

Article 660 of the Civil Code provides, among other things, that:

> The proprietor below is not at liberty to raise any dam, or to make any other work, to prevent this running of water.

The court has consistently regarded this provision as prohibiting any obstruction of a natural stream that damages the upper owner by hindering the natural drainage of his lands,[86] unless the upper owner has long acquiesced in the arrangement,[87] or the parties have agreed to such obstruction and alteration of the drainage,[88] or the parties had acquired their lands from a person who owned both their properties and had changed the natural drainage prior to the disposition of the parcels.[89]

---

[84] Shaffer v. State National Bank, 37 La. Ann. 242, 248 (1885).

[85] See Planiol, Marcel, Treatise on the Civil Law, 12th Ed., Translation by the Louisiana State Law Institute (1959), Vol. 1, No. 2419, for a French interpretation of Art. 664, Code Napoleon 1804, from which Art. 661 of the Louisiana Civil Code was evidently borrowed.

[86] Hooper v. Wilkinson, 15 La. Ann. 497 (1860); Darby v. Miller, 6 La. Ann. 645 (1851); Herbert v. Hudson and Lamberth, 13 La. 54 (1839); Petit Anse Coteau drainage Dist. v. Iberia & V. R. Co., 124 La. 502, 50 So. 512 (1909); Vidrine v. Guillory, 3 La. App. 462 (App. 1925).

[87] Becknell v. Weindhal, 7 La. Ann. 291 (1852).

[88] Guillory v. Fontenot, 170 La. 345, 127 So. 746 (1930); Barrilleaux v. Delaune, 176 La. 377, 145 So. 776 (1933); Elam v. Cortinas, 219 La. 406, 53 So. 2d. 146 (1951). See also Robertson v. Lebermuth, 132 La. 318, 61 So. 388 (1913).

In a very early case (in 1826) in which a lower riparian owner had constructed a milldam in such a way that the impounded water prevented a prior milldam upstream from being used, the court applied the Spanish Civil Law (Par. 3, title 32, law 18), which specifically provided that a man could not erect a mill near another so as to obstruct the current of water to that previously erected.[90] This case was cited as authority by the court in a 1921 case in which a riparian owner was allowed damages for injury caused by floodwaters backed up because a railroad had partially obstructed the river downstream.[91]

The court has recently taken a more direct approach in a case in which the damage caused was not brought about by an interference with drainage but by actual flooding caused by the obstruction. Under L.S.A.–Civil Code, Article 2315, which provides that: "Every act . . . that causes damage to another, obliges him by whose fault it happened to repair it . . .", a person building a "cofferdam" in a stream was required to compensate a person injured by the flooding of his land by waters backed up by the dam.[92]

In any event, it seems that, unless there is some form of agreement to the contrary between the parties,[93] any obstruction of a natural nonnavigable watercourse which causes water damage to another is actionable.

There have been no reported court decisions involving the right of an upper riparian owner to dam or obstruct a nonnavigable stream so as to cause the natural flow of the stream to be hindered, diminished, or stopped entirely and thereby reduce or cut off the flow which would benefit those below. Article 661 of the Code specifically provides that a riparian owner "cannot stop" a stream. Whether this means that he cannot diminish or partially obstruct the flow, or only that he cannot stop it completely, is not entirely clear. It is possible that the courts would interpret this provision in the interests of agriculture to allow a reasonable obstruction, but what this might be in any particular case is difficult to say.[94]

A case in 1885 involved the damming of an artificial canal so as to obstruct its flow which was used by an adjoining plantation. The court said a contractual agreement governed its use but that the contract was in accord with Articles 660, 661, and certain other Code articles. It said that these articles, "are to the effect that the owner of the estate which owes the servitude, can do nothing tending to diminish its use, or to make it more inconvenient." It concluded that the dams involved, "were illegal obstructions, and that the plaintiff cannot be required to endure them, unless for a time in cases of unavoidable necessity . . ." While the court adhered to a rather strict rule of liability, it based this on rules adopted in earlier cases that were not directly in point. At any rate, as the case involved an artificial canal and apparently could have been decided by the terms of the contract, it is problematical whether it would be given much weight regarding the above question concerning the proper construction of the words "cannot stop" in Article 661.[95]

---

[89] Hebert v. Champagne, 144 La. 659, 81 So. 217 (1919); Rodriguez v. Prevost, 129 La. 940, 57 So. 276 (1912).

[90] Boatner v. Henderson, 5 Mart. (N.S.) 186 (La. 1826).

[91] Miller v. Texas & P. Ry. Co., 148 La. 936, 88 So. 123 (1921).

[92] Magee v. Texas Construction Co., 227 La. 32, 78 So. 2d. 500 (1955). Also see note 77, supra.

[93] Or perhaps certain other extenuating circumstances such as those mentioned above in text at notes 87 to 89.

[94] Recall earlier discussions of reasonable use rule in considering extent of permissible irrigation under Article 661. See *Irrigation,* supra.

It may be noted also that legislation provides that: "No person diverting or impeding the course of water from a natural drain shall fail to return the water to its natural course before it leaves his estate without undue retardation of the flow of water outside his enclosure thereby injuring an adjacent estate." Violators may be fined and/or imprisoned.[96]

Another statute provides that no person shall willfully obstruct natural drainage creeks, bayous, or small rivers, "or any public or private drainage." Violation of this statute provides for a fine of from $25 to $100, and costs. In default of payment, imprisonment is provided for, and failure to remove an obstruction is prima facie evidence of willful intent.[97]

Navigable Watercourses

Definition

Watercourses may be classified as to their navigability. In Louisiana a river or stream is navigable in law when it is navigable in fact.[98] In determining whether it is navigable in fact, the court has applied the general rule followed by the United States Supreme Court in a case in 1874 (87 U.S. 430, 441) as follows:

> The capability of use by the public for purposes of transportation and commerce affords the true criterion of the navigability of a river, rather than the extent and manner of that use. If it be capable in its natural state of being used for purposes of commerce

---

[95] Shaffer v. State National Bank, 37 La. Ann. 242 (1885). The case is discussed more fully under *Artificial Watercourses,* infra.

[96] L.S.A.–R.S. 38:218. Also see note 82, supra.

[97] L.S.A.–R.S. 38:215. In addition, R.S. 38:214 provides that no person shal dump or discharge any materials which might interfere with the drainage into any waters or drains. Violation of the statute calls for a fine of from $25 to $300.

[98] State v. Jefferson Island Salt Mining Co., 183 La. 304, 163 So. 145 (1935); State v. Sweet Lake Land & Oil Co., 164 La. 240, 113 So. 833 (1927); McClusky v. Meraux & Nunez, 186 So. 117, 120 (App. 1939). Particularly for purposes of determining bed ownership, the court has considered whether the water involved was navigable a the time of the state's admission to the Union. See *Ownership of Beds* and *Natural Lakes and Bayous,* infra.

Watercourses which are navigable in fact are classified as navigable in law.

> no matter in what mode the commerce may be conducted, it is navigable in fact, and becomes in law a public river or highway.[99]

The Louisiana court has indicated that the *capacity* of a watercourse for some commercial use, even though not *actually* so used, may be considered.[100] While some reported decisions include the above-quoted reference to the "natural state" of a stream, the court in one case decided that a stream was nonnavigable partly on the grounds that it ". . . could not be made navigable by dredging and clearing the stream, . . ." at least without incurring great expense.[101]

---

[99] State v. Jefferson Island Salt Mining Co., 183 La. 304, 163 So. 145, 150 (1935). Accord: State v. Capdeville, 146 La. 94, 83 So. 421 (1919); Transcontinental Petroleum Corp. v. Texas Co., 209 La. 52, 24 So. 2d. 248, 253 (1945); Delta Duck Club v. Barrios, 135 La. 357, 65 So. 489, 490 (1914); Delta Duck Club v. Barrios, 135 La. 364, 65 So. 491 (1914).

In one case, the court quoted approvingly from a Massachusetts case as follows: "It is not every small creek in which a fishing skiff or gunning canoe can be made to float at high water which is deemed navigable, . . . it must be generally and commonly useful to some purpose of trade or agriculture." The court added: "It implies the possibility of transporting men and things."[102]

In another case, the court concluded that a stream could be considered navigable notwithstanding that ". . . its free navigation may be at times encompassed with difficulties by reason of natural barriers such as rapids and sandbars or accumulations of timber . . ."[103]

The court has said that the question of navigation is one of fact, depending upon the evidence in each case.[104] Evidence considered in one case where a stream was held to be nonnavigable included (1) the lack of any actual use of the stream by any water craft for the purpose of commerce, although small boats with detachable gasoline engines used it occasionally, (2) the treatment by the United State Government of the stream as nonnavigable, as shown by its authorization of the construction of stationary bridges across it, (3) the fact that it was narrow, filled with sand, gravel bars, stumps and logs, and had a fall of from 2½ to 5 feet to the mile, and, if cleaned out, its current would have been a torrent, (4) the considerable rise and fall of the stream in a few hours, and (5) the depth of the waters at average stage.[105]

---

[100] State v. Jefferson Island Salt Mining Co., State v. Capdeville, and Transcontinental Petroleum Corp. v. Texas Co., supra.

[101] Bodcaw Lumber Co. v. Kendall, 161 La. 337, 108 So. 664, 665-666 (1926).

Some later Federal decisions also have considered the possibility of artificial improvements. See United States v. Appalachian Power Co., 311 U.S. 377, 407-409 (1940) so holding in a case involving the licensing by the Federal Power Commission of a hydroelectric dam. The court said that navigability, for the purpose of the regulation of commerce, may arise after the admission to statehood. "In determining the navigable character of New River it is proper to consider the feasibility of interstate use after reasonable improvements which might be made." The court also said, "There must be a balance between cost and need at a time when the improvement would be useful." (Cited in dissenting opinion in State v. Aucoin, 206 La. 786, 20 So. 2d. 136, 160 (1944).

It may be noted that Federal legislation cited in the above Federal case, which gives the Federal Power Commission certain licensing powers, defines "navigable waters" for this purpose as bodies of water which in their "natural or improved condition" are "used or suitable for use" for transporting persons or property in interstate or foreign commerce, notwithstanding that they may be interrupted by "falls, shallows, or rapids compelling land carriage." See 16 U.S.C.A. sec. 796 (8).

Also see Laurent, Francis W., "Judicial Criteria of Navigability in Federal Cases," 1953 Wisconsin Land Review No. 1, p. 8, to the effect that somewhat different criteria have been followed for different purposes.

[102] Burns v. Crescent Gun and Rod Club, 116 La. 1038, 41 So. 249, 251 (1906).

[103] Goodwill v. Police Jury of Bossier Parish, 38 La. Ann. 752, 755 (1886). But in Egan v. Hart, 45 La. Ann. 1358, 14 So. 244 (1893), the court held the upper part of a bayou to be nonnavigable which dried up and became ". . . choked with rafts and filled with sand, reefs, etc . . ." at many places each summer. See 30 Tulane Law Rev. 332 (1956) regarding tests of navigability.

[104] State v. Capdeville, 146 La. 94, 83 So. 421, 425 (1919); Cert. den. Atchafalaya Land Co. v. Capdeville, 40 S. Ct. 346, 252 U.S. 581, 64 L. Ed. 1011 (1920).

The question of use by small boats vs. other uses of streams classified as nonnavigable under the above-described test has not been directly in issue in any case that has come to the authors' attention. The Supreme Court has said in one case that streams might be "floatable streams" serving as highways for the transportation of logs and other property.[106] This concept of "floatable streams" perhaps introduces a third class of watercourse to the normal classification of navigable and nonnavigable watercourses. The court said that persons other than the riparian owner might have rights in such a class of streams, but did not spell out what these rights might be. Apparently a riparian owner might be required to allow other persons (at least other riparian owners) to use the stream for the transportation of logs and other property.

The language used by the court as to floatable streams, however, was not necessary for a decision of the case under consideration and must be considered as merely an incidental statement, not carrying the full authority of the actual holding in the case. Moreover, not only has the language never been adopted by the court in any later decision (the case was decided in 1917), but the writers have been unable to discover any other mention of the concept of "floatable streams" in any reported appellate or Louisiana Supreme Court decision. Under these circumstances, it cannot be definitely said that the concept of "floatable streams" is accepted in Louisiana. At present, it seems that the only classes of watercourses that have legal significance are those which are and those which are not navigable.[107]

Ownership of Beds

The basic rule concerning the ownership of the beds of navigable rivers and streams is that the state owns all lands lying beneath the navigable waters, between the normal low watermarks.[108] (The Supreme Court has indicated that title to the beds of navigable rivers, streams, and lakes was acquired by the state on its admission to the Union by virtue of its sovereignty.[109]) This land cannot now be transferred to private ownership by the state, as the Louisiana Constitution of 1921 provides:

---

[105] Amite Gravel and Sand Co. v. Roseland Gravel Co., 148 La. 704, 87 So. 718, 719 (1921). See also State v. Capdeville, 146 La. 94, 83 So. 421 (1919); Transcontinental Petroleum Corp. v. Texas Co., 209 La. 52, 24 So. 2d. 248, 253 (1945), where the width, depth, and location of the waters were considered.

[106] Palmer Co. v. Wilkinson, 141 La. 874, 75 So. 806, 810 (1917).

[107] L.S.A.—R.S. 38:291 provides that any artificial waterway created by any levee district, where the waterway is navigable in fact and connects with any navigable water, may be dedicated by the levee district as a waterway subject to free and unrestricted navigation by the public. See *Artificial Watercourses*, infra, for a brief discussion of navigation canals.

[108] State v. Richardson, 140 La. 329, 72 So. 984, 991 (1916); State v. Capdeville, 146 La. 94, 83 So. 421, 425 (1919); Wemple v. Eastham, 150 La. 247, 90 So. 637 (1922);

> Nor shall the Legislature alienate, or authorize the alienation of the fee of the bed of any navigable stream, lake or other body of water, except for purposes of reclamation.[110]

Prior to 1921, however, there was no Constitutional limitation on the power of the Legislature to alienate the beds of navigable waters, and it was within the Legislature's power to issue patents to these lands. A 1912 act provides that actions to annul any patent issued by the state, and duly signed and recorded in the prescribed manner, must be brought within 6 years reckoned from the day of the issuance of the patent or the passage of the act.[111] In 1954, the court held that,

---

[108] *(Continued)*
Smith v. Dixie Oil Co., 156 La. 691, 702, 101 So. 124 (1924); Pizanie v. Gauthreaux, 173 La. 737, 741, 138 So. 650 (1931).

Moreover, the public has rights to use certain lands lying along a navigable river for certain purposes connected with navigation or the making or repairing of levees, etc. See e.g., L.S.A.—C.C. Arts. 455 and 665; and other statutes and constitutional provisions as discussed in Delaune v. Bd. of Comm'rs, Pontchartrain Levee Dist., 230 La. 117, 87 So. 2d. 749 (1956); Hebert v. James and Co., 224 La. 498, 70 So. 2d. 102, (1954); Bd. of Comm'rs, Pontchartrain Levee Dist. v. Baron, 236 La. 846, 109 So. 2d 441 (1959). Among other things, these cases discuss L.S.A.—Const. 1921, Art. 16, sec. 6 regarding compensation for property used or destroyed for levees or levee drainage purposes.

[109] Transcontinental Petroleum Corp. v. Texas Co., 209 La. 52, 24 So. 2d. 248, 253 (1945). See also Smith v. Dixie Oil Co., 156 La. 691, 101 So. 24 (1924); State v. Bozeman, 156 La. 635, 101 So. 4 (1924); Ellerbe v. Grace, 162 La. 846, 111 So. 185 (1927); State v. Erwin, 173 La. 507, 138 So. 84 (1931); Miami Corp. v. State, 186 La. 784, 173 So. 315 (1937), cert. denied 302 U.S. 700. See also 2 Stat. 666; 33 U.S.C.A. sec. 10; 2 Stat. 642 and 703.

It should be noted, however, that the U.S. Supreme Court has indicated that the Federal government could validly have conveyed the beds under navigable waters in the Louisiana and other territories in furtherance of appropriate public purposes, to a limited extent, although it otherwise held such beds in trust for the benefit of the states later created out of the territories. In holding that the beds under nonnavigable waters in the Oklahoma part of the Louisiana Territory had been conveyed to an Indian tribe prior to Oklahoma's admission as a state, the court found it unnecessary to decide whether the bed could validly have been conveyed to the tribe even if the water were navigable. Brewer—Elliott Oil & Gas Co. v. United States, 260 U.S. 77, 85-86 (1922), affirming 270 F. 100 (8th C.C.A., 1920), which affirmed 249 F. 609 (1918).

Questions regarding the validity and effect of old Spanish grants to lands in the Louisiana Territory are considered in Menard's Heirs v. Massey, 49 U.S. (8 How.) 293 (1850), discussed in Begnaud v. Grubb and Hawkins, 209 La. 826, 25 So. 2d. 606, 610 (1946).

Questions regarding the Oyster Statutes (See L.S.A.—R.S. 56:421 *et seq.*) declaring that certain waterbeds should remain the property of the state are considered in Onebane, Joseph, "Who Owns the Water Bottoms?" 6 La. Bar Journal No. 1, p. 46 (May, 1958).

[110] L.S.A.—Const. of 1921, art. 4, § 2.

[111] Acts 1912, No. 62, § 1. This section also applied to "any transfer of property by any sub-division of the state . . ." It is now embodied in L.S.A.—R.S. 9:5661.

by virtue of this act, the state could not in the 1954 case attack the validity of a patent so issued and recorded to the beds of navigable waters. While the patent in question was issued in 1874, the court apparently would have held likewise if the patent had been issued anytime before the Constitutional limitation of 1921.[112]

Later in 1954, the Legislature, apparently not satisfied with this decision, passed an act aimed at nullifying it. The act provides that the intent of the 1912 Legislature was that the prescriptive statute should not apply to the transfer of navigable waters or the beds of same,[113] that any patent or transfer of navigable waters and the beds thereof is null and void,[114] and that no statute enacted by the Legislature shall be construed as to validate by reasons of prescription any patent or transfer of navigable waters or the beds thereof.[115] It would seem possible that this act might be unconstitutional as retroactive legislation divesting vested rights[116] although it has not as yet been passed upon by the court.[117]

The state also has been declared to be the owner of the beds of navigable rivers under the Civil Code[118] and of the beds of navigable waters by at least two other statutes.[119] But the court in the above-mentioned case reasoned that, no matter what the policy of the Legislature might have been regarding the ownership of beds of navigable waters, it was within the Legislature's power to grant ownership thereof to private individuals prior to the 1921 constitutional restriction. While apparently there had been no legislative pronouncements authorizing the issuance of patents to beds of navigable waters prior to 1912, the court indicated that because of the 1912 prescriptive statute, the validity of such grants cannot be attacked at this late date.[120]

---

[112] California Co. v. Price, 225 La. 706, 74 So. 2d. 1 (1954), decided by a divided court. See also 234 La. 338, 99 So. 2d. 743 (1957). Thus, the last year in which the state might have attacked any such patents was 1927—six years after the 1921 cut-off date for validly issuing such patents.

[113] La. Acts 1954, No. 727, § 1, now embodied in L.S.A.—R.S. 9:1107.

[114] La. Acts 1954, No. 727, § 2, now embodied in L.S.A.—R.S. 9:1108.

[115] La. Acts 1954, No. 727, § 3, now embodied in L.S.A.—R.S. 9:1109.

[116] See L.S.A.—Const. of 1921, Art. 4, § 15.

In accord with this view, see Hebert, P. M., and Lazarus, C. E., "Legislation Affecting the Civil Code," 15 La. Law Rev. 1, 23-24 (1954); Onebane, Joseph, "Who Owns the Water Bottoms?" 6 La. Bar Journal No. 1, p. 46, 64 (May, 1958).

[117] It may be noted that the court in the above-mentioned case indicated with respect to certain prior legislation that "if the recital be construed as referring also to previously disposed of property, it would be subject to a constitutional attack as divesting vested rights." California Co. v. Price, 225 La. 706, 74 So. 2d. 1, 7 (1954).

[118] Article 453 of the Code provides that the beds of navigable rivers are publicly owned "as long as the same are covered with water." (See note 124, infra.) The bed of a navigable stream that was nonnavigable in 1812 may have been privately owned. (See *Nature of Riparian Rights*: *Ownership of Beds,* supra.) It seems doubtful that when it later became navigable the state thereby acquired title to its bed. See 65 C.J.S., Navigable Waters, sec. 97.

[119] L.S.A.—R.S. 9:1101 and L.S.A.—R.S. 56:421. See *Nature of Riparian Rights,* supra. See also discussion of possible application of La. Civil Code, Art. 482 to navigable lakes and bays, in California Co. v. Price, 225 La. 706, 74 So. 2d 1, 10-11 (1954).

Aside from these possible exceptions, however, the state now owns in fee, and cannot transfer ownership of, the beds of any navigable waters.[121]

Right to Use Water

Although there is little authority on which to base an opinion, it seems probable that L.S.A. Civil Code, Article 661, which gives riparian owners certain rights to use running water,[122] either is inapplicable to navigable rivers or streams or is subservient to provisions of the Code and Revised Statutes that give the state and public rights in such streams.

Article 661 does not explicitly distinguish between navigable and nonnavigable watercourses. This is in direct contrast to the comparable French Civil Code provision, which definitely exempted navigable streams from its application.[123] As the Louisiana provision is almost certainly based on the French law, it would seem that there is some significance in this omission. It would have been a simple matter for the codifiers to have inserted this exception in the Louisiana provision had they intended it to apply.

On the other hand, in L.S.A.—Civil Code, Article 453, navigable rivers are cited as an example of public things, the property of which is vested in a whole nation, and the use of which is allowed to all its members.[124] This is in accord with the early French treatment of the subject and seems to indicate that the French law was meant to be followed. It is not easy to reconcile the vesting of navigable rivers in the public by Article 453 with an interpretation of Article 661 which might give to the riparian owners a vested right in their use.

---

[120] California Co. v. Price, 225 La. 706, 74 So. 2d. 1 (1954).

[121] See *Nature of Riparian Rights*: *Ownership of Beds,* supra., regarding streams that have ceased to be navigable.

[122] See Appendix, infra.

[123] Code Napoleon, 1804, Art. 644: "He whose estate borders on running water other than that which is declared to belong to the public domain by Article 538 under the title *of the Classification of Property,* may use it as it runs for the purpose of watering his estate."

Par. 2 was similar to Par. 2 of L.S.A.—Civil Code Art. 661. See note 51, supra (Translation from L.S.A.—Civil Code Art. 661, History and Text of Former Codes.)

Code Napoleon, 1804, Art. 538, referred to in Art. 644, declared navigable streams to be a part of the public domain; hence these streams were outside the scope of Art. 644. Riparian owners had no special rights to use navigable waters according to Planiol, Marcel, *Treatise on the Civil Law,* op. cit. (note 85), Vol. 1 No. 2428. See also Wiel, S.C., "Waters: American Law and French Authority," op. cit., note 61, 33 Harvard Law Review, p. 152.

[124] L.S.A.—Civil Code, Art. 453: "Public things are those, the property of which is vested in a whole nation, and the use of which is allowed to all the members of the nation: Of this kind are navigable rivers, seaports, roadsteads and harbors, highways and the beds of rivers, as long as the same are covered with water . . ."

See also Article 450 in Appendix, infra.

The Legislature evidently intended the state to have paramount rights in navigable waters, for in L.S.A.–R.S. 9:1101 it expressly provided ". . . that the ownership of the water itself . . .is vested in the state and that the state has the right to enter into possession of these waters when not interfering with the control of navigation exercised thereon by the United States of America."[125]

It may be noted also that while the beds of nonnavigable streams generally belong to the riparian owners, the beds of navigable rivers and other navigable waters generally belong to the state.[126] L.S.A.–Civil Code, Article 505 provides: "The ownership of the soil carries with it the ownership of all that is directly above it . . ." Although running water itself cannot be owned privately,[127] the article may nevertheless lend some support to the proposition that the state and public have paramount rights to use such waters.[128]

With respect to the use of navigable rivers, the court in an 1883 case refused to enjoin a company owning land along the Mississippi River (whose land was separated from it only by a public levee and street) from laying pipes to the river to withdraw water for its domestic and manufacturing purposes.[129] The injunction was requested by a waterworks company that was supplying the City of New Orleans with water under an exclusive franchise to do so. The court indicated that the waterworks company ". . . in common with all the inhabitants of the city, possessed, independent of any legislative grant or concession, the right to draw water from the river for its own purposes, and to supply the city and its inhabitants with it." Although the company had acquired an exclusive charter to supply the city, it contained an exception allowing the city to grant permits to "contiguous" landowners to lay water pipes to the river for their own use. But the court said that even without such an exception, riparian landowners: ". . . had, clearly, not only the privilege, *in common with all others,* to draw the running water from the river for domestic purposes, *ad lavandum et potendum,* but also, on principle, that, without the need of a previous permission, of laying pipes from the river to their premises, to draw the water necessary for their use." (Emphasis added.)[130] However, the nature of the privilege or right of riparian landowners or others to use the river was not clearly defined, nor was any significance of the navigability of the river discussed.

---

[125] The Legislature perhaps could not have divested by this pronouncement rights which may have been vested in individuals prior to the passage of the act in 1912. See note 52, supra. But since L.S.A.–Civil Code, Article 453, which was enacted previously, clearly states that navigable rivers are public, it seems unlikely that any riparian rights to use these waters are vested in private persons.

[126] See *Ownership of Beds,* and *Nature of Riparian Rights*: *Ownership of Beds,* supra.

[127] See *Nature of Riparian Rights,* supra.

[128] An analagous situation exists in the use of oil and gas. The court has said that even though oil and gas are insusceptible of ownership in their free state beneath the surface of the ground, the right to reduce them to possession exists in the owner of the soil above them. McCoy v. Arkansas Natural Gas Co., 175 La. 487, 143 So. 383, 85 ALR 1147, cert. denied, 287 U.S. 661, (1932); Continental Securties Corporation v. Wetherbee, 187 La. 773, 175 So. 571 (1937). If the analogy is sound, it would seem that the owners of the soil beneath running water would have a right to reduce it to possession also. See note 54, supra. This would mean that the state, being the owner of the soil beneath navigable streams, would have the right to utilize the waters from these streams, and that the riparian owner would not have a vested right in these streams. The same reasoning would, of course, strengthen the argument that riparian owners have vested rights to utilize nonnavigable running water.

[129] New Orleans Waterworks Co. v. Louisiana Sugar Refining Co. and City of New Orleans, 35 La. Ann. 1111 (1883); dismissed for want of jurisdiction in 125 U.S. 18 (1888).

In any event, the rights to drainage granted under L.S.A.—Civil Code, Article 660, probably are applicable to both nonnavigable and navigable streams, and any infringement of the rights of riparian or other landowners granted under it would seem to furnish a cause of action to the injured party.[131] On the other hand, it is clear that the public has the right to use navigable waters for fishing[132] and navigation.[133]

---

[130] The city had granted the defendant company permission to lay pipes to the river for its domestic and manufacturing purposes. The court indicated that this constituted a valid exercise of its police power to regulate the laying of pipes across the river bank and public street.

The court did not mention Article 661 of the L.S.A.—Civil Code dealing with riparian rights. But it did cite Articles 450, 453, 455, and 457 of the Code, which deal with common and public things and the definition of river banks, in connection with its assertion that the city "had the right of permitting the defendant company to lay pipes and conduits across the quay and through the streets, from the river to within its factory limits, for the purpose of supplying itself with the water needed for its objects."

In the appeal of this case to the U.S. Supreme Court, that court noted, at 125 U. S. 32, that this case was distinguishable from an earlier case where it had enjoined the taking of water from the same river for use in a hotel, partly on the grounds that in the former case the defendant was not an owner of land "contiguous to the river." New Orleans Water Works Co. v. Rivers, 115 U.S. 674 (1884). However, in that case the court seems to have been more concerned with the abovementioned exception of "contiguous" owners in the charter of the waterworks company than with any question of riparian rights of such owners. Other Federal cases involving this same charter include New Orleans Water Works Co. v. Southern Brewing Co., 36 Fed. 833 (1888), aff'd in 145 U.S. 649 (1891), and New Orleans Water Works Co. v. New Orleans, 164 U.S. 471 (1896).

In Doiron v. O'Bryan, 218 La. 1069, 51 So. 2d 628, 632 (1951), the court included a definition of riparian rights, as: "The rights of owners of lands on the banks of watercourses relating to the water, its use, ownership of soil under the stream, accretions, etc." See *Nature of Riparian Rights,* supra. This case involved a navigable lake, but it was dealing only with the question of ownership of formerly submerged land adjoining the lake. It may be doubted whether the quoted statement would have any material significance on the question of rights to use the waters of navigable rivers, streams, or lakes.

[131] See *Nature of Riparian Rights,* supra.

[132] L.S.A.—Civil Code, Art. 453, supra, note 124, provides that "every man has a right freely to fish in rivers, ports, roadsteads, and harbors." See also Burns v. Crescent Gun and Rod Club, 116 La. 1038, 41 So. 249 (1906) and Haynes v. Smith discussed in note 308, infra.

[133] See L.S.A.—Civil Code, Art. 453 (supra, note 124) and R.S. 9:1101 (infra, Appendix). Also see 33 U.S.C.A. sec. 10 which provides that "all the navigable rivers

Although the right to free navigation of navigable rivers is given the public, the court in 1931 cast some doubt upon how far the state courts would go in protecting the interest of an individual in this right. The court was presented with a case in which the plaintiff had constructed a canal upon his own land, diverting water from a navigable stream. According to the court, the evidence was conflicting as to whether the river beneath the point of the diversion had been rendered nonnavigable by the diversion, and, if so, whether by the action of the plaintiff in diverting water from the river. The canal had been constructed for the purposes of navigation, and tolls were apparently charged. The defendant felt, however, that since the water had been diverted from a navigable stream, he had the right to use the canal without cost. The plaintiff then sought to enjoin the defendant from such free use of the canal. He was granted the injunction in the lower court. The State Supreme Court affirmed this decision on the grounds that the defendant could not, as a remedy for a wrongful diversion by plaintiff, use the canal free of charge, as such a remedy was not recognized in Louisiana.

In the course of the decision, the court used the following language:

> And of course there is ample authority for the proposition that one may be enjoined from diverting so much of the flow of navigable streams as to render them unnavigable.[134]
>
> But in our opinion, the Congress of the United States, which has plenary powers over the navigable waters of the nation, has placed the whole subject-matter of diverting the water of a navigable stream under the jurisdiction of the Secretary of War, who is far more capable of dealing with such matters than are the courts, since he can get his information at first hand and on the spot; and it is within his discretion to say how much, and under what con-

---

133 (*Continued*)
and waters in the former territories of Orleans and Louisiana shall be and forever remain public highways." (Derived from an 1811 act relating to adjustment of land claims and sale of public lands in these territories. 2 Stat. at 666.) Act of Congress April 8, 1812; 2 Stat. 701, which admitted Louisiana into the Union, contained the following provision: "*Provided* that it shall be taken as a condition upon which the said state is incorporated into the Union, that the river Mississippi, and the navigable rivers and waters leading into the same, and into the Gulf of Mexico, shall be common highways and forever free, as well to the inhabitants of the said state as to the inhabitants of other states and the territories of the United States, without any tax, duty, import, or toll therefor imposed by the said state . . ." 2 Stat. 703. Louisiana cases construing this provision include Harvey v. Potter, 19 La. Ann. 264, 92 Am. Dec. 532 (1867); Boykin & Long v. Shaffer, 13 La. Ann. 129 (1858); Carondelet Canal & Navigation Co. v. Parker, 29 La. Ann. 430, 29 Am. Rep. 339 (1877).

Also see California Co. v. Price, 225 La. 706, 74 So. 2d. 1, 3, 11 (1954) where it was conceded that even though the bed of a navigable bay was susceptible of private ownership, the waters were subject to public rights of navigation, commerce, and fishing. This possibility of private bed ownership and public rights in the waters is criticized in a dissent to the opinion, at page 13.

[134] The court cited no authority, however.

ditions, the water of navigable streams may be diverted. See Act Cong. March 3, 1899 § 10 (33 U.S.C.A. § 403).[135]

The holding in the case would seem to be only that the defendant could be enjoined from using the canal which the plaintiff had built on his land, leaving defendant to other remedies if the plaintiff's diversion was wrongful. But the above-quoted language indicates that the defendant would not have had a remedy in the Louisiana courts. The act of Congress cited by the court,[136] however, does not read as though exclusive jurisdiction over diversion of navigable waters had been placed in the Secretary of War (now called Secretary of the Army).[137] In fact, cases noted under this statute in the *United States Code Annotated* indicate that concurrent Federal and State jurisdiction may be exercised.[138] Although the Louisiana Supreme Court has neither repudiated nor modified the language set forth above in any subsequent case, the writers do not feel that it would today refuse jurisdiction if faced squarely with a case concerning the diversion of navigable rivers.

Congress has granted the Corps of Engineers, U. S. Army, certain regulatory authority over the construction of dams and alteration of the course or capacity of navigable waters.[139] The Federal Power Com-

---

[135] Ilhenny v. Broussard, 172 La. 895, 135 So. 669, 670 (1931).

Similarities between the Federal and Louisiana Courts' criteria for determining whether a stream is navigable are discussed in 30 Tulane Law Rev. 332 (1956). Also see *Navigable Watercourses*: *Definition*, supra. Congress has specifically declared Bayou Cocodrie (from its source to its junction with Bayou Chicot) and Eagle Lake to be nonnavigable for Federal purposes. 33 U.S.C.A. secs. 21 and 47.

[136] 33 U.S.C.A. § 403: ". . .; and it shall not be lawful to excavate or fill, or in any manner to alter or modify the course, location, condition, or capacity of, any port, roadstead, haven, harbor, canal, lake, harbor of refuge, or inclosure within the limits of any breakwater, or of the channel of any navigable water of the United States, unless the work has been recommended by the Chief of Engineers and authorized by the Secretary of War prior to beginning the same."

[137] The Secretary of War was changed to Secretary of the Army by Act July 26, 1947, c. 343, Title II § 205 (a), 61 Stat. 501.

[138] Leitch v. City of Chicago (C.C.A. Ill.), 41 F 2d. 728, cert. den., 282 U.S. 891, 51 S. Ct. 106, 75 L. Ed. 786 (1930); Robinson v. Silver Lake Ry. & Lumber Co., 153 Wash. 261, 279 P. 1109 (1929); North Shore Boom & Driving Co. v. Nicomen Boom Co. (Wash.), 29 S. Ct. 355, 357, 212 U.S. 406, 53 L. Ed. 574 (1909); Cummings v. Chicago (Ill.), 23 S.Ct. 472, 477, 188 U.S. 410, 47 L. Ed. 525.

[139] See, e.g., 30 Stat. 1151; 33 U.S.C.A. secs. 401 and 403. With respect to the withdrawal or diversion of such waters, see Sanitary Dist. v. United States, 266 U.S. 405 (1925); United States v. Ormsbee, 74 F. 207 (1896).

The Corps of Engineers also has engaged in several channel-improvement and other projects in aid of navigation. The writers have been informed that in planning projects the corps gives consideration to the provision of liberal supplies of fresh water, as well as sufficient water for navigation purposes in waterways during low-water periods. (Based on information supplied by Col. G. M. Cookson, District Engineer, U. S. Army Engineer District, New Orleans.)

It may be noted that La. Acts 555 (1958) proposed an amendment of the La. Const. of 1921, which has been ratified by the people. Art. IV, sec. 12, as amended, property or rights of way, easements, or other servitudes, now owned or later acquired, to the United States for use in connection with the construction, maintenance and improvement of artificial and natural navigable waterways and river and harbor mission also has certain regulatory authority over such waters, particularly with respect to the construction of hydroelectric power dams.[140]

Contrary to the expressed lack of intention to take jurisdiction over cases involving diversion of navigable streams, the Louisiana Supreme Court has clearly and often held that a navigable stream cannot be obstructed without authorization from the state.[141] Obstruction, in fact, is made a criminal act by two separate statutes. The first of these statutes deals with *aggravated obstruction* which is the intentional or criminally negligent placing of anything, or performance of any act, on any navigable waterway *wherein it is foreseeable that human life might be endangered.*[142] The second deals with *simple obstruction,* which is the intentional or criminally negligent placing of anything, or performance of any act, on any navigable waterway *that will render movement thereon more difficult.*[143] In 1958 the Legislature enacted the Uniform Pleasure Boating Act which specifies various rules of law and requirements

---

[139] (*Continued*)
or flood-control works, or in connection with parks, forest preserves, canals, and irrigation districts. The state or any of its agencies also may maintain in cooperation with or on behalf of the United States or any of its agencies rights of way, servitudes, or easements acquired in connection with the construction or improvement of artificial or natural waterways.

[140] See, e.g., 41 Stat. 1065 and 1353, 46 Stat. 798, 49 Stat. 839; 16 U.S.C.A. sec. 797 (e). It may also be noted that in 1958 the Congress enacted legislation "to provide for more effective integration of a fish and wildlife conservation program with Federal water-resource developments, and for other purposes." 72 Stat. 563, amending earlier legislation. This act provides, among other things, that the head of the agency exercising administration over the water resources of the state (See State Wildlife and Fisheries Commission, infra), and the U.S. Fish and Wildlife Service, Department of the Interior, shall be consulted with a view to the prevention of loss of and damage to wildlife resources, whenever the waters of any stream or other body of water are proposed or authorized to be impounded, diverted, or otherwise controlled or modified for any purpose by any Federal department or agency or by any public or private agency under Federal permit or license. This does not apply, however, to "projects for the impoundment of water where the maximum surface area of such impoundments is less than ten acres . . ."

[141] Goodwill v. Police Jury of Bossier Parish, 38 La. Ann. 752 (1886). (Injunction granted to prevent parish from filling in navigable stream); Ingram v. Police Jury of the Parish of St. Tammany, 20 La. Ann. 226 (1868). (Injunction granted to prevent parish from building low bridge over navigable stream); Clement v. Louisiana Irrigation & Mill Co., 129 La. 825, 56 So. 902 (1911). (Mandatory injunction for removal of dam across navigable river); Blanchard v. Abraham, 115 La. 989, 40 So. 379 (1906); Armistead v. Shreveport & R.R. Val. Ry. Co., 108 La. 171, 32 So. 456 (1901); Darrall v. Southern Pac. R. Co., 47 La. Ann. 1455, 17 So. 884 (1895); Houston v. Police Jury of St. Martin, 3 La. Ann. 566 (1848).

[142] L.S.A.—R.S. 14:96: "Aggravated obstruction of a highway of commerce is the intentional or criminally negligent placing of anything, or performance of any act, on any railway, railroad, navigable waterway, road, highway, thoroughfare, or runway of an airport, wherein it is foreseeable that human life might be endangered.

"Whoever commits the crime of aggravated obstruction of a highway of commerce shall be imprisoned at hard labor for not more than fifteen years."

[143] L.S.A.—R.S. 14:97: "Simple obstruction of a highway of commerce is the intentional or criminally negligent placing of anything or performance of any act on

applicable to the operation of pleasure boats.[144] The act provides that its provisions shall be construed to supplement applicable federal laws and regulations when not expressly inconsistent therewith. The act requires all political subdivisions and peace officers and game wardens to enforce its provisions, but prohibits the adoption of local pleasure boating regulations by political subdivisions.

No reported Louisiana court decision or Federal court decision arising in the state, appears to have dealt with the question of whether riparian or other uses of nonnavigable watercourses or parts of watercourses which connect with navigable waters shall be subject to limitation if they affect adversely navigation or other public uses of the navigable waters. However, the U.S. Supreme Court and other Federal courts have so indicated in certain cases dealing with questions of Federal control.[145]

Nonriparian Use

Although under the "riparian doctrine," which is followed in Louisiana, those who own lands on the banks of certain watercourses are given certain rights to use water which probably are not given to those who do not own such lands, it is clear that riparian owners are not granted the *exclusive* use of *all* the watercourses of the state.

In the case of navigable watercourses, it is questionable whether riparian owners have materially greater rights to use the waters than the public generally, although they generally have the advantage of easier access to the river. However, as this subject was covered under the preceding topic, the discussion here is limited to the rights of nonriparian owners in nonnavigable watercourses.

Article 661, L.S.A.–Civil Code, grants to riparian owners certain rights to the use of running water, but it does not expressly exclude nonriparian owners from the use of such water.[146] Since nowhere in the Code, statutes, or reported court decisions are nonriparian owners

---

143 (*Continued*)
any railway, railroad, navigable waterway, road, highway, thoroughfare, or runway of an airport, which will render movement thereon more difficult.

"Whoever commits the crime of simple obstruction of a highway of commerce shall be fined not more than two hundred dollars, or imprisoned for not more than six months, or both."

[144] L.S.A.–R.S. 34:850.1 et seq. Among other rules, pleasure boats shall not be operated in areas legally designated and marked as restricted areas for swimming or other purposes.

[145] See, e.g., Oklahoma v. Atkinson Co., 313 U.S. 508, 525 (1940) with respect to the power of flood control and navigation; and Georgia Power Co. v. Federal Power Commission, 152 F. 2d. (C.C.A. 5th) 908, 913 (1946) with respect to a non-Federal hydroelectric power dam, construing the statutory regulatory power of the Federal Power Commission, cited earlier, with particular reference to 16 U.S.C.A. sec. 817.

[146] See Appendix, infra.

The usual French interpretation of the comparable provision (sec. 644 of the Code Napoleon 1804) limited the use of nonnavigable streams primarily to riparian landowners, although nonriparian use rights could be acquired, as against expressly granted any rights in such water, it would seem unlikely that anyone has a *duty* to allow nonriparian owners to use the water. (It has not been clearly decided how Article 450 regarding "things which are in common . . . such as . . . running water" shall apply to nonnavigable watercourses. But it would seem probable that its provision "which all men may freely use, conformably with the use for which nature has intended them" would be held to be subject to the provisions in Article 661, which give riparian landowners certain rights in running water.[147])

Such questions may arise when a nonriparian owner has gained access to a stream through some type of arrangement with a riparian owner, or by other means. It would seem that at least two basic types of arrangements might be made to allow a nonriparian owner access to a stream. First, the riparian owner might grant a mere right of way or passage to the stream; and second, he might grant his rights, in whole or in part, to the water itself.

When a mere right of way to the stream has been granted to a nonriparian owner by a riparian owner, and the nonriparian owner is using the water from the stream, the question arises as to whether a second riparian owner can maintain an action against the nonriparian user.[148] If, for example, the nonriparian owner is withdrawing water

---

[146] (*Continued*)

particular riparians, by such means as purchase, condemnation, or prescription—according to Wiel, S. C., "Origin and Comparative Development of the Law of Watercourses in the Common Law and in the Civil Law," 6 Calif. Law Rev. 245 and 342, at pp. 259 and 365 et. seq. (1918).

The author added, at p. 350, that such rights of use were given to riparian owners because of the inconveniences and dangers which the presence of the waters often cause. (Incidentally, the French irrigation law of April 29, 1845, removed all doubt that riparian owners could use water on nonriparian estates owned by them and gave them special rights in connection with the traversing of intervening estates, according to Planiol, Marcel, *Treatise on the Civil Law*, op. cit., note 85, Vol. 1, No. 2417.)

[147] See Article 450 in Appendix, infra; Palmer Co. v. Wilkerson, supra, note 52; Shaffer v. State National Bank, supra, note 59; 16 La. L. Rev. 500, 506 (1956); and L.S.A.—Civil Code, Vol. 3, pp. 9 and 12.

The state may now own the running waters in natural rivers and streams, by virtue of L.S.A.—R.S. 9:1101. But the beds of nonnavigable streams that were nonnavigable in 1812 generally are owned by the riparian owners. See *Nature of Riparian Rights: Ownership of Beds*, supra. The effect, if any, of such ownership of running waters by the state, and of the beds by the riparian owners, on rights to use the waters in nonnavigable watercourses has not been clearly decided. See text at notes 53 and 54, supra.

[148] Article 727, L.S.A.—Civil Code, cites as examples of conventional discontinuous servitudes the rights of passage and of drawing water. Thus, it would seem possible for the owner of riparian land to create, by any act sufficient to transfer title, a real right in the owner of nonriparian land to convey water across the riparian land. See Articles 727, 743, and 756, L.S.A.—Civil Code. Also see note 62, supra. (Or he might create a personal right to do so in the nonriparian owner that would not be attached to the ownership of the nonriparian land. See L.S.A.—Civil Code, Articles 757 and 758.) However, the question of the nonriparian owner's right to withdraw water from the watercourse would still remain unanswered.

from a nonnavigable stream with which to irrigate his lands that do not lie on the watercourse, can lower riparian owners maintain an action against the withdrawer with a showing of actual or impending damage caused by this withdrawal? Can they maintain an action if actual or impending damage cannot be shown? Can both an action for damages and injunctive relief be maintained?

These questions must be left unanswered, as there appears to be very little authority upon which to base answers. It would seem probable that, in general, a showing of damage would form the basis for a stronger case than when damage cannot be shown, but we cannot make a more detailed prediction of what the answers might be.

When a riparian owner grants his *rights* in the stream to a nonriparian owner, a different problem is posed. Here the question is not so much a matter of the rights of the nonriparian owner as such, but rather a matter of the right of a riparian owner to transfer his riparian rights to the nonriparian owner. As between the transferring riparian owner and the nonriparian owner, a contract transferring riparian rights might be binding. Article 752, L.S.A.–Civil Code, provides that ". . . servitudes . . .which result from the situation of places, may be altered by the agreement of the parties, provided the public interest does not suffer thereby." This would seem clearly to permit alteration of the riparian servitude as between upper and lower landowners.[149] It might also provide some support for the validity of contracts between riparian and nonriparian landowners. But it is less likely that other riparian owners on the stream would be bound by such an arrangement without their consent.[150]

Article 654 of the Code reads as follows:

> Servitude is a right so inherent in the estate to which it is due, that the faculty of using it, considered alone and independent of the estate, cannot be given, sold, let or mortgaged without the estate to which it appertains, because it is a servitude which does not pass to the person but by means of the estate.

This article would seem to indicate that the riparian owner's right to use running water, a servitude under Article 661, could not be transferred to a nonriparian owner for the use of his nonriparian land.[151]

Although there are no State Supreme Court cases touching on this point, in an appellate court case, a contract by which the owner of land on one side of a bayou allowed a nonriparian owner to take water from the bayou and convey it across his riparian land was upheld against the objection of the owner of the land on the opposite side of the bayou.[152] But in this case, the court was not sure whether the bayou was a running stream or still water. Moreover, although the court felt that probably it was *not* a running stream, it did not indicate what difference it would have made if it had been. The plaintiff alleged that "under the laws of this state" the defendant had "no right in or to said water, he not being a riparian owner . . ." But the court did not deal with this question. It refused to enjoin the defendant's use solely on the basis of the general rule that an injunction would not be issued unless actual or impending damages were shown.

---

[149] See note 63, supra, regarding the execution of such a contract.

[150] He might acquire such a right as against specific riparian owners through contractual agreements with them. See note 62, supra.

The foregoing three sentences are in general accord with the usual French interpretation of the Code Napoleon (1804) as described in Wiel, op. cit. (note 146) at pp. 365-367.

[151] Also see L.S.A.–Civil Code, Arts. 652 and 653.

From the above, it would seem possible that nonriparian owners might have a privilege to withdraw water from nonnavigable streams at least as long as they have access to the streams and are neither injuring nor threatening to injure riparian owners. However, there seems to be little upon which to base an opinion as to nonriparians' rights to use the water of nonnavigable streams.

There is also uncertainty regarding the question of the use of the waters of a nonnavigable stream by a riparian owner on *non*riparian land that he may own or rent. Recall that Article 661, L.S.A.–Civil Code, provides only that "He whose estate borders on running water may use it as it runs, for the purpose of watering his estate, or for other purposes."[153] This, in turn, raises the question of the nature of riparian land.

Nature of Riparian Land

The court has said that riparian rights are: "The rights of owners of land on the *banks of watercourses* relating to the water, its use . . ., etc."[154] (Emphasis added.) This suggests that riparian lands at least include those which lie *on the banks* of rivers and streams. The quotation above is contained in an opinion dealing with rights to land adjoining and underlying a lake, and there are, in fact, no cases reported in which the court has decided what constitutes riparian land for the purpose of deciding rights to use running water. This includes the question of how far back from the watercourse a tract of land may extend and still be considered riparian land.[155] There are, however, a

---

[152] Jackson v. Walton, 2 La. App. 53 (1925). The case is discussed more fully later, under *Natural Lakes and Bayous.*

[153] See *General Nature of Riparian Rights: Right to Use of Water,* supra.

[154] Doiron v. O'Bryan, 218 La. 1069, 51 So. 2d. 628 (1951). See note 130, supra.

[155] Courts in some other states have held or said that land must be within the watershed of a watercourse to be considered riparian to it. See 56 Am. Jur., Waters, sec. 278. Courts in some states have further held or said (1) that riparian land does not include subsequent additions of nonriparian tracts to the original riparian tracts of land, and (2) that if a part of a riparian tract of land that is not contiguous to the stream is conveyed to another, the part conveyed ceases to be riparian land (unless it is otherwise provided in the conveyance), even though it may be later reunited with the riparian tract. See 56 Am. Jur., Waters, sec. 277.

On the other hand, according to Wiel, op. cit., (note 146) at p. 349, et. seq., the usual French interpretation of Art. 644 of the Code Napoleon (1804), which was similar to Art. 661 of the Louisiana Civil Code, was that what constituted rigreat number of cases involving riparian lands that are concerned with the ownership of land adjoining and underlying streams and rivers. As it would seem likely that riparian lands would be the same for both purposes, at least in many instances, we here examine the law concerning the riparian rights to soil adjoining and beneath watercourses.

Construing Grants and Conveyances

A number of cases dealing with rights to land adjoining watercourses have involved the question of whether a particular conveyance of land has transferred a riparian estate. In deciding such cases, the court has sought to determine whether the parties to the transfer intended a riparian estate to pass.[156] It was early (1819) stated that an intention to pass a riparian estate entitled to soil formed along a river bank (called "alluvion") could be manifested either by words in the deed expressly making the river a boundary of the estate or by the grantor transferring an estate such that no land susceptible of private ownership exists between the river and the transferred estate, even though the river is not made a boundary of the estate.[157]

---

[155] (*Continued*)
parian land should be determined by considering the situation at the time of the attempted use. This meant that land not contiguous to a stream could be added to contiguous land and the entire tract would become riparian if contiguous and held in one common ownership. This legally could include land outside the watershed but use of water thereon would usually be considered unreasonable as a question of fact.

Such a view, in general, would more nearly accord with the literal wording of Art. 661, which reads: "He whose estate borders on running water, may use it as it runs, for the purposes of watering his estate . . ." etc.

Such questions apparently have not been decided in Louisiana. The Louisiana court has said that ascertaining whether land is riparian is a key question in determining whether it is subject to the public servitude imposed by L.S.A.—Civil Code, Art. 665 upon lands lying along navigable rivers for the making and repairing of levees, etc. Such servitude came into existence when the property was separated from the public domain. If the land does not actually front on the river it becomes necessary to trace the title to the original grant to ascertain whether it was then riparian. See, e.g., Bd. of Comm'rs, Pontchartrain Levee District v. Baron, 236 La. 846, 109 So. 2d. 441, 443-444, (1959); Delaune v. Bd. of Comm'rs, Pontchartrain Levee Dist., 230 La. 117, 87 So. 2d. 749, 754 (1956). The court apparently has not further spelled out its criteria for such purposes. It is problematical to what extent it might follow such criteria of riparian land for water-use purposes, but it need not necessarily follow it. See the reasoning employed and the emphasis on Art. 665's use of the word "adjacent," said not to require contact with the river, rather than "adjoining." In contrast, Art. 661 employs the words "he whose estate borders on running water" and "through whose estate water runs." It may be noted that in one early case the court noted that several early grants of land in Louisiana "were made with narrow fronts on the rivers and running back a great depth . . ." Bicknell v. Weindalh, 7 La. Ann. 291, 292 (1852). See also Zenor v. Parish of Concordia, 7 La. Ann. 150 (1852). But in a number of instances, different persons may now own the front and back portions of such tracts.

[156] The court has been interested mainly in determining whether the estate is riparian for purposes of deciding title to alluvion, there being no such case reported concerning rights to water.

[157] Morgan v. Livingston, 6 Mart. (O.S.) 19 (1819).

Because a conveyance which expressly designates a river as one boundary of the transferred land is quite clearly a conveyance of a riparian estate, few cases have been presented to the court for a decision as to whether a riparian estate has been transferred by express language. In 1819, the court held that an estate conveyed with a "front to the river" was a riparian estate because of the use of these words.[158] "Front on the river" also has been held sufficient to describe a riparian estate.[159] However, in other cases the court has held that "front to the river" would not necessarily indicate a riparian estate when other factors in the description indicated otherwise. The words "front to the levee" have likewise been held not necessarily to convey a riparian estate.[160]

One group of cases concerning rights to lands adjoining and underlying watercourses have involved meander lines. Meander lines are generally lines run in a survey of public lands to define the banks of certain bodies of water, generally but not necessarily navigable, and to determine the quantity of public land subject to patent or sale by the government.[161] The curving banks of a body of water are represented by a series of straight lines, as the surveyor moves from point to point along the bank. Depending upon the surveyor's skill, the distance between points along the bank, the degree to which the banks actually deviate from a straight line, and other such factors, the meander lines will more or less accurately represent the true shoreline. Often, however, the meander lines do not coincide exactly with the true shoreline.

A conflict arises in these cases when the state or Federal government, or one of its agencies, grants land to an individual, using a meander line as one of the stated boundaries. If the state or Federal government, or someone claiming under a patent therefrom, asserts title in land which might lie between the meander line and the actual shoreline because of the meander line's location, it must be determined whether the conveyance to the first party was intended to convey only to the meander line, or to the true shoreline. In other words, it must be determined whether a transfer of land with a meander line as a boundary actually transfers a riparian estate.

In a syllabus by the State Supreme Court added to a 1917 decision, the general rule was stated to be:

> The general rule is that meander lines are not run as boundaries of the land surveyed, but for the purposes of defining . . . the banks of the stream or other body of water and as a means of ascertaining

---

[158] Ibid.

[159] La. Branche's Heirs v. Montegut, 47 La. Ann. 674, 17 So. 247 (1895).

[160] Cochran v. Fort, 7 Mart. (N.S.) 622, 624, 625 (La. 1829); Cambre v. Kohn, 8 Mart. (N.S.) 572, 579, 580 (La. 1830); Livingston v. Heerman, 9 Mart. (O.S.) 656, 721 (La. 1821). In all of these cases land susceptible of private ownership existed between the actual boundary and the river, and the court held that the vendors retained title to this land, which was riparian.

[161] Palmer Co. v. Wilkinson, 141 La. 874, 75 So. 806, 808 (1917), citing Horne v. Smith, 159 U.S. 40 (See p. 43) (1895) and another Federal case.

> the quantity of land embraced in the survey. The stream or other body of water, and not the meander line as actually run on the ground, is the boundary.[162]

The court has recognized an exception to this rule, however:

> . . . but this rule has been held to apply only where the distance between such meander line and the actual shoreline is comparatively small. It is not applied where . . . the real shoreline is distant from the supposed shoreline, and there is a large area of land between the supposed shoreline, as shown on the plat, and the actual shoreline.[163]

A meander-line boundary, then, generally signifies a riparian estate unless the meander line lies far back from the true shore.

On nonnavigable streams, another question could arise from the fact that the riparian owners, not the state, generally own the beds of the streams. L.S.A.–R.S. 9:2971 reads as follows:[164]

> It shall be conclusively presumed that any . . . conveyance . . . affecting land described as fronting on or bounded by a waterway . . . shall be held . . . to include all of the grantor's interest in and under such waterway . . . whatever that interest might be in the absence of any express provision therein particularly excluding the same therefrom; provided that where the grantor at the time of the transfer . . . holds as owner the title to the fee of the land situated on both sides thereof and makes a transfer or other grant affecting the land situated on only one side thereof, it shall be conclusively presumed, in the absence of any express provision therein particularly excluding the same therefrom, that the transfer . . . thereof shall include the grantor's interest to the center of such waterway . . .[165]

---

[162] Palmer Co. v. Wilkinson, 141 La. 874, 75 So. 806 (1917).

The court indicated that the same general rule would apply to grants by either the state or Federal government of land adjoining watercourses. (75 So. at p. 808.) While this case involved primarily a state patent, the court applied the same general rule in two cases involving a Federal patent. Land v. Brockett, 162 La. 519, 110 So. 740 (1926); Thigpen v. Noonan, 162 La. 527, 110 So. 743 (1926). It would seem, however, that this would not necessarily result if a patent or deed clearly indicated an intention *not* to convey land beyond the meander line nor any riparian rights in the bed or waters of the watercourse.

[163] Acadia-Vermilion Rice Irrigating Co., Inc. v. Miller, 178 La. 954, 152 So. 576, 577 (1933). Accord: Bruning v. City of New Orleans, 165 La. 511, 115 So. 733, 737 (1928) regarding the effect of a deed; Land v. Brockett and Thigpen v. Noonan, supra; Smith v. Horne, supra, 159 U.S. 40, 42-43 (1895). Cf. Hall v. Board of Commr's, 111 La. 913, 35 So. 976 (1904) regarding a swampland grant.

Another possible exception arises where the meander lines signify a body of water that does not in fact exist. See Palmer Co. v. Wilkinson, supra, 75 So. at p. 808. Also see State v. Aucoin, 206 La. 786, 20 So. 2d. 136 (1944), regarding traverse lines run in regard to swampland grants by the United States.

For a discussion of various aspects of swampland grants, see 6 La. Bar Journal No. 1 (supra, note 116).

[164] This provision was added in 1956. La. Acts 1956, N. 555.

[165] See Nattin v. Glassel, 156 La. 423, 100 So. 609 (1924) discussed in note 43, supra, regarding the application of perhaps somewhat different rules prior to this

It should be noted that this statute creates a presumption that not only title to the bed of a stream is to pass with a transfer of riparian land, but all rights *in* the waterway are to pass also. It should be noted further, however, that it apparently is possible to reserve these rights by express language.

An important test for determining the intention of the parties appears to be that of noting whether everything susceptible of private ownership has been conveyed. Three objects that can intervene between the conveyed estate and the river are a levee, a public road, and alluvion. It is well established that neither a public road nor a levee will prevent an estate that would otherwise be on the river from being riparian.[166] The rule as to the effect of the intervention of alluvion between the conveyed estate and the river has been developed such that "if at the time of the sale of riparian land, the alluvion attached has attained a sufficient elevation above the waters to be susceptible of private ownership, the alluvion does not pass with the land, unless so expressed."[167] Conversely, if the alluvion is not sufficiently formed at the time of sale to be susceptible of private ownership, it passes to the purchaser.[168] Alluvion is susceptible of ownership when it rises above the ordinary low water stage of the river.[169] Questions regarding alluvion are discussed further below.

---

[165] (*Continued*)
legislation. The 1956 statute gave persons one year from August 1, 1956, to take action to protect prior rights that might be adversely affected, by bringing suit or by recording a notarized declaration asserting such rights in the conveyance records of the proper parish. L.S.A.—R.S. 9:2973. The statute also includes a proviso that its rules relative to the conveyance of land adjoining a waterway shall not affect any "then existing valid right of way upon, across or over said property so transferred or conveyed . . ."

[166] Morgan v. Livingston, 6 Mart. (O.S.) 19, 251 (La. 1819); Municipality No. 2 v. Orleans Cotton Press, 18 La. 122, 239, 240, 36 Am. Dec. 624 (1841); Succession of Delachaise v. Maginnis, 44 La. Ann. 1051, 11 So. 715, 718 (1892). Also see note 177, infra, and note 108, supra.

[167] Barre v. City of New Orleans, 22 La. Ann. 612, 613 (1870). See also Cochran v. Fort, 7 Mart. (N.S.) 622, 625 (1829); Ferriere v. City of New Orleans, 35 La. Ann. 209, 210 (1883). This rule does not override particular words in a deed which convey a riparian estate, however. To this point see La Branche's Heirs v. Montegut, 47 La. Ann. 674, 17 So. 247 (1895), where alluvion was formed at the time of a mortgage of land described in the mortgage as "a sugar plantation on the left bank of the Mississippi river, having a front of one-fourth of one arpent, more or less, on said river, by eighty arpents in depth." The purchaser under foreclosure got a riparian estate.

[168] Meyers v. Mathis, 42 La. Ann. 471, 7 So. 605 (1890). It is not clear whether the right to future alluvion might be reserved by the grantor in a conveyance of riparian land. R.S. 9:2971, set forth later in the text of this section, implies that rights in the land beneath a waterway might be specifically reserved by the grantor; but in the *Delachaise* case cited in the text below, the court indicated that title to alluvion is incapable of existing apart from the riparian estate. This latter would seem to be the better view, for otherwise the conveyed riparian estate would cease to be on the river as alluvion formed to its front.

[169] State v. Richardson, 140 La. 329, 72 So. 984, 991 (1916); Seibert v. Conservation Commission of Louisiana, 181 La. 237, 159 So. 375 (1935).

Shifting Shores and Channels

Several of the problems connected with the determination of riparian land stem from the very nature of the rivers and streams in Louisiana. The continued shifting of the shores of many rivers and streams because of their soil-building and erosive propensities has been a never-ending source of litigation to define the lands that border on or lie near rivers as riparian or nonriparian.

L.S.A.—Civil Code, Articles 509 to 518 deal specifically with the effects of changes in the location of soil, caused by actions of streams and rivers. Article 509, probably the most important of these articles, defines the accretion formed "successively and imperceptibly" to soil situated on the shore of a river or stream as *alluvion,* and gives this alluvion to the owner of the soil situated on the edge of the stream o river, whether or not it is navigable.[170]

Article 510 applies this same rule to dereliction formed by the rive or stream retiring imperceptibly from one of its shores. Conversely i denies to the owner of the shore upon which a river encroaches an claim to soil carried away.[171] But Article 511 allows the owner of soi which is carried away by a *"sudden irruption"* of a river or stream t claim the land that was washed away if it can be identified and i claimed within one year.[172]

Alluvion formed in front of the property of several riparian owner is to be divided according to the frontage of each owner at the time c formation of the alluvion.[173]

---

[170] The court has indicated that this may apply even though the process c forming accretions was initiated by the act of man, such as by the constructio of a cut-off channel across a bendway. It has said that the decision in such case should depend on principles of equity. Esso Standard Oil Co. v. Jones, 233 La. 91 98 So. 2d. 236, 241 (1957), cited supra, note 15. See also 32 Tulane Law Rev. 31 323 (1958).

Article 509 also provides, however, that the riparian owner ". . . is bound leave public that portion of the bank which is required by law for the publ use." See note 16, supra, for the complete article.

[171] L.S.A.—Civil Code, Art. 510: "The same rule applies to derelictions forme by running water retiring imperceptibly from one of its shores and encroachin on the other; the owner of the land, adjoining the shore which is left dry, has right to the dereliction, nor can the owner of the opposite shore, claim th land which he has lost."

"This right does not take place in case of derelictions of the sea."

Arts. 509 and 510 have been construed by the court in a number of cases. S L.S.A.—Civil Code, Arts. 509 and 510, Notes of Decisions.

[172] L.S.A.—Civil Code, Art. 511: "If the river or stream, whether navigable not, carries away by a sudden irruption a considerable tract of land from adjoining field, which tract of land is susceptible of being identified, by carrying th same on a field lower down, or on the opposite shore, the owner of the tra of land thus carried away, may claim his property, provided he does it with a year, or even after the year has elapsed, if the person, to whose land the so thus carried away has been united, has not yet taken possession of the same."

[173] L.S.A.—Civil Code, Art. 516: "If an alluvion be formed in front of t property of several riparian proprietors, the division is to be made accordi to the extent of the front line of each at the time of the formation of the alluvion

As for the rights in and to the use of the waters themselves, it is not clear what the effect of shifting shores or channels might be. It seems probable, however, that those estates that are considered riparian for purposes of determining rights in and to alluvion would also be considered riparian for purposes of determining the right to use water.

An excellent summary of the law applicable to title to alluvion is contained in the syllabus by the court in *Succession of Delachaise v. Maginnis.*[174] It reads as follows:

> 1. . . .
> 2. The principle underlying and usually determining the title to alluvion, in our system, is expressed in the equitable maxim, 'qui sentit onus, sentire debet et commodum! (He who bears the burden ought also to be entitled to the advantage.)[175]
> 3. Another principle, equally germinal, is that title to alluvion is a purely accessary right, attaching exclusively to the riparian estate, and incapable of existing without it.
> 4. A party who sells the entire estate owned by him up to the line of a public road or street bordering the river, and beyond which no property susceptible of private ownership exists at date of sale, retains no estate to which the accessary right to future alluvion could attach.
> 5. The intervention of a public road or street does not prevent the owner of the estate adjacent thereto from being considered as the front or riparious proprietor, when nothing susceptible of private ownership exists between the road or street and the river.
> 6. Such adjacent estate must bear the whole loss resulting from any encroachment by the river, furnishing space for a new road or street if the old is washed away;[176] and the law, as well as justice, awards him the corresponding benefit from accession.[177]
> 7. The vendor of the lots adjacent to the road is subject, on the other hand, to no risk of loss, and has, therefore, no legal or equitable claim to any future accretion.

Land cut off from the fields of an individual by a river or stream opening a new channel in such a way that the land becomes an island, remains his property, whether the watercourse is navigable or nonnavigable.[178] Thus, islands formed by the river depositing soil are distinguished from those formed by a shift in the channel. Those formed by deposited soil generally belong to the state in navigable streams,[179] and those similarly formed in nonnavigable streams are divided among the riparian owners;[180] while those formed by the river shifting channels belong to whoever owned the land at the time of the channel shift.

---

[174] 44 La. Ann. 1043, 11 So. 715 (1892).

[175] Authors' insertion in parentheses.

[176] See Ruch v. City of New Orleans, 43 La. Ann. 275, 9 So. 473 (1891).

[177] Apparently, it makes no difference whether the public road is entirely owned by the city or state, or merely a servitude with the ownership of the soil in the riparian owner. In both cases, the road will not prevent the estate from being riparian. See Municipality No. 2 v. Orleans Cotton Press, 18 La. 122, 237-244 (1841). L.S.A.–Civil Code, Article 658, provides that "the soil of public roads belongs to the owner of the land on which they are made, though the public has the use of them." (Authors' footnotes.)

It may be noted also that Article 518 provides:

> If a river or stream, whether navigable or not, opens itself a new bed by leaving its former channel, the owners of the soil newly occupied shall take, by way of indemnification, the former bed of the river, every one in proportion to the quantity of land he has lost.
>
> They shall again take their former property, if the river or stream returns to its former channel.

In the case of navigable streams, this article should not present many difficulties in its application, for in most instances, it would result only in what was formerly public land—the bed of a navigable stream (see *Navigable Rivers and Streams,* supra)—becoming private land in exchange for the formerly private land becoming public land; i.e., the state would become the owner of the newly formed bed of the navigable river, and the former owners would become owners of the old bed, which was originally the state's.[181]

The ownership of the beds of nonnavigable streams ordinarily is in the riparian owners.[182] Therefore, if the stream changes its course, the owner of the land newly covered by the stream might retain this land as a riparian owner, and might, at the same time, be granted the ownership of the original bed which was owned by the former riparian owner. However, another interpretation of the article might be that the land newly covered by the stream would become the property of the persons who formerly owned the old bed and not the property of the landowners adjacent to the new bed, as the article perhaps intends that its operation should result in an exchange of rights.

Another question involved in the nature of riparian estates is presented when a river completely erodes away a riparian estate such that an estate which formerly lay behind the original riparian estate becomes the new riparian estate. If the river then adds alluvion to

---

[178] L.S.A.—Civil Code, Art. 517: "If a river or stream, whether navigable or not, by opening itself a new branch cuts off and surrounds the field of any individual owner of the shore, and makes it an island, the owner shall keep the property of his field."

[179] L.S.A.—Civil Code, Art. 512: "Islands and sandbars, which are formed in the beds of navigable rivers or streams, and which are not attached to the bank, belong to the state, if there be no adverse title or prescription."

[180] See L.S.A.—Civil Code, Arts. 513, 514 and 515, included in note 41, supra.

[181] Fitzsimmons v. Cassity, 172 So. 824, 829 (La. App., 1937). Article 453 of L.S.A.—Civil Code provides that "navigable rivers . . . and the beds of rivers, as long as the same are covered by water . . ." are "public things."

[182] See *Nature of Riparian Rights,* supra.

Who owns accretions formed by silt deposits along streams or bays?

this new estate, does the original estate reappear, or does the new riparian estate take title to the alluvion? Logic and the law would seem to indicate that the new riparian estate should gain title to the alluvion, but in the one case where such a situation seemed to be presented, the court held that the law applicable to submergence and reemergence applied, rather than the laws regarding alluvion and, therefore, the original riparian estate was recreated.[183] Although the court did not mention the Civil Code articles, it in effect applied the above-quoted Article 518 rather than Article 509. It would appear, however, that where the court cannot find Article 518 applicable, it would be compelled to hold that once a riparian estate is lost to the river, it is forever lost. This would be so because by Article 509 the owner of the land on the water's edge becomes the owner of the accretions added to the land.[184] Thus, as the estate which had been eroded into the river is replaced by new alluvial deposits, these new deposits would become part of the estate to which they are added. As the eroded estate reappeared, then, it would reappear as additions to the estate which lay on the water's edge at the time the accretions began to be formed; and even though the former riparian estate might be entirely replaced, it would be replaced as an addition to the estate which originally had not been on the banks of the river.

Pollution Control by Public

The rights of individuals to pollute watercourses[185] are affected by certain statutes designed to protect public rights to these watercourses.

Anyone who intentionally performs any act tending to contaminate any private or public water supply, when the act foreseeably endangers the life or health of human beings is to be fined not more than $1,000 or imprisoned for not more than 20 years, or both. If the act does not foreseeably endanger the life or health of human beings, the fine is not to exceed $500, nor the imprisonment 5 years.[186]

---

[183] Hughes v. Birney's Heirs, 107 La. 664, 32 So. 30 (1902).

[184] See text at note 170, supra.

[185] See *Pollution,* supra.

[186] L.S.A.–R.S. 14:58.

Oil and gas well operators receive particular attention under a statute which provides that no person is to discharge oil, salt water, or other noxious or poisonous substances or gases into any stream from which water is taken for irrigation purposes, and which would render it unfit for irrigation purposes or would destroy the fish therein,[187] except during an open season which extends from October 1 to December 31, inclusive, of each year. During the open season, these products may be released into the streams. A watchman must be provided by the well operators night and day during the rest of the year to prevent leaks, breaks, secret pipes, or violation of this law.

The statute does not apply, however, to the discharge of these waters into those portions of natural streams having a normal salt content of more than 110 grains per gallon or into the tributaries of such streams if the tributary joins the stream where it has such salt content. These streams are recognized as being unfit for irrigation. Nor does the statute apply to streams having their source outside Louisiana or to the tributaries of such streams.[188]

A fine of not less than $100 nor more than $2,000, or an imprisonment for not less than 30 days nor more than 3 months is provided for each violation. Each day that the provisions of the statute are violated constitutes a separate offense.

Two identical statutes provide that no person shall discharge into any of the waters of the state any substance that kills fish, or renders the water unfit for the maintenance of normal fish life characteristics, or in any way adversely affects the interests of the state. Fine and/or imprisonment is provided for violation.[189]

Perhaps the broadest powers of control over pollution are placed in a commission known as the Stream Control Commission.[190] The commission has control of waste disposal, public or private, by any person,[191] into any of the waters of the state[192] for the prevention of pollution tending to destroy fish or wildlife, or domestic animals, or to be injurious to the public health or welfare.[193] It may enter at all reasonable times upon private or public property for the purpose of inspecting and investigating conditions relating to the pollution of any waters of the state.[194]

---

[187] See also *State Wildlife and Fisheries Commission,* infra, for other statutes dealing with the protection of fish.

[188] L.S.A.–R.S. 38:216. See State v. Hincy, 130 La. 620, 58 So. 411 (1912) in which a prior act (Act No. 163 of 1910) was held constitutional.

[189] L.S.A.–R.S. 56:322 and L.S.A.–R.S. 56:362. The former provision relates to the protection of sport fishing and the latter to commercial fishing.

[190] The Commission consists of the Commissioner of Wildlife and Fisheries, the President of the State Board of Health, the Commissioner of Conservation, the Commissioner of Agriculture and Immigration, the Executive Director of the Department of Commerce and Industry, and the Attorney General, or their authorized representatives. L.S.A.–R.S. 56:1431.

[191] L.S.A.–R.S. 56:1433: " 'Person' includes any municipality, industry, public o private, or co-partnership, firm, or any other entity."

[192] L.S.A.–R.S. 56:1433: " 'Waters of the state' includes rivers, streams, lakes, and all other water courses and waters within the confines of the state, and all bordering waters, including the Gulf of Mexico."

[193] L.S.A.–R.S. 56:1434.

The powers and duties of the commission are defined as follows:

The commission:

(1) Shall establish such pollution standards for waters of the state in relation to the public use to which they are or may be put as it deems necessary;

(2) May ascertain and determine for record and for use in making its orders what volume of water actually flows in any stream, and the high and low water marks of waters of the state affected by the waste disposal or pollution of any person;

(3) May by order or regulation control, regulate, or restrain the discharge of any waste material or polluting substance discharged or sought to be discharged into any water of the state.

(4) May prohibit any discharge resulting in pollution which is unreasonable and against the public interest in view of the existing conditions in the waters of the state.[195]

The Commissioner of Wildlife and Fisheries is to enforce and administer the statutes relating to the commission and the rules, regulations, and orders of the commission through the agents and enforcement officers of the Commission of Wildlife and Fisheries.[196]

It is provided that no person is to discharge, or permit to be discharged, into any waters of the state any waste or pollution that tends to destroy fish or wild or domestic animals or fowls or to be injurious to the public health or welfare in violation of any rule, order, or regulation of the commission,[197] under penalty of fine and/or imprisonment.[198]

Administrative machinery is provided for the commission to carry out its functions. When in the opinion of the commission any person violates or is about to violate any of the above provisions, or fails to control the polluting content or waste discharged or to be discharged into any waters of the state, the commission may notify the alleged offender of such determination. The person must within 10 days from such notification file a full report showing what steps have been and are being taken to control the pollution. The commission may then make such orders as in its opinion are necessary. In an emergency that causes or threatens irreparable damage, or if the public interest requires it, the commission may issue a temporary order requiring the pollution to be stopped pending a hearing. "The temporary order shall not be effective for more than five days beyond the date of the hearing and in no event for more than twenty days."[199]

---

[194] L.S.A.–R.S. 56:1438.

[195] L.S.A.–R.S. 56:1439.

[196] L.S.A.–R.S. 56:1437.

[197] L.S.A.–R.S. 56:1440.

[198] L.S.A.–R.S. 56:1444.

Any person who feels aggrieved by any order or restriction of the commission may file a petition with the commission asking for a hearing of the matter involved. The commission must then fix the time and place of the hearing and notify the petitioner. Following the hearing, the final order of determination of the commission is conclusive. The order may be reviewed anew, however, in the District Court of East Baton Rouge upon petition. On such review, the decree of the court takes the place of the order of the commission.[200]

In 1947, the act creating the Stream Control Commission[201] was attacked as unconstitutional under the Fourteenth Amendment of the United States Constitution and under the Louisiana Constitution. In Texas Co. v. Montgomery,[202] the Texas Company brought a bill in equity before a Federal District Court against the Commissioner of Wildlife and Fisheries, seeking a preliminary injunction. The court held the act to meet the test of due process and not to conflict with the prohibitions of the State Constitution cited by petitioner which were in issue before the court.[203] The court mentioned, however, that there might be merit in the petitioner's contention that the act violates the State Constitution in that it vests power in the commission to declare what conduct shall constitute a misdemeanor, a power that can be exercised only by the Legislature,[204] but as no criminal action under the act was before the court, it did not decide this point.[205]

Another statute dealing with pollution of streams provides that:

> No person shall knowingly and wilfully empty or drain or permit to be emptied or drained from any pump, reservoir, well, or oil field into any natural stream of the state any oil, salt water, or noxious or poisonous gases or substances in quantities sufficient to destroy the fish therein.[206]

This statute is followed immediately by the following provision:

> The commissioner of wildlife and fisheries shall supervise all drainage of salt water and other noxious substances into the natural streams of the state. Any owner or operator or oil producing property or oil tanks or reservoirs discharging salt water or any other noxious substances into the natural streams of this state in quantities sufficient to kill the fish therein shall, when notified by the commissioner of wildlife and fisheries, immediately im-

---

[199] L.S.A.–R.S. 56:1441.

[200] L.S.A.–R.S. 56:1442.

[201] L.S.A.–Acts 1940, No. 367. This act is now embodied in L.S.A.–R.S. 56:1431 et. seq.

[202] 73 F. Supp. 527 (1947); affirmed 332 U.S. 827 (1947).

[203] Texas Co. v. Montgomery, 73 F. Supp. 527, 536 (1947).

[204] Id. at 535.

[205] Id. at 536.

[206] L.S.A.–R.S. 56:1451.

> pound such substances. Substances so impounded may be released by permission of the commissioner of wildlife and fisheries.[207]

Violation of these two statutes calls for fine or imprisonment.[208] Apparently, they are supplementary to L.S.A.–R.S. 38:216 (discussed above[209]), which also regulates pollution of streams by oil-well operators. R.S. 38:216 seems to be designed primarily for the protection of irrigation, and its restrictions are applicable only to pollution of streams used for irrigation having their sources within Louisiana. The two statutes quoted above appear to be applicable to pollution of any natural streams, but are limited to pollution affecting fish life, other pollution not being within their scope.

The State Commissioner of Conservation, who administers oil and gas conservation laws, has authority to make reasonable regulations and orders, after notice of hearing, to prevent the pollution of fresh water supplies by oil, gas, or salt water; and conversely to prevent or regulate the intrusion of water into oil or gas strata.[210]

Diffused Surface Waters

A law dictionary defines "surface waters" as waters which "diffuse themselves over the surface of the ground, following no defined course or channel, and not gathering into or forming any more definite body of water than a mere bog or marsh."[211]

There is only one reported case[212] in Louisiana which discusses the right of a person possessing lands to use the diffused surface waters that lie on his land. In this case the Second Circuit Court of Appeal of Louisiana, which was faced with a situation in which an owner of an upper estate had constructed terraces on his land such that waters were diverted away from a natural drain onto the lower owner's land at a point other than that at which they naturally would enter, said that:

> The action of defendant in constructing the terrace was certainly within itself a lawful act, and for the purpose of improving his property, and rendering it better adapted for agriculture; and even conceding that Article 661 of the Civil Code is applicable to surface waters which fall upon the land from the clouds, it must be construed with the preceding article[213] and with the rule of construction which has been universally followed by the Supreme Court of this state in its application of the law to cases where one of the owners of contiguous estates has constructed works for improving and cultivating his land.

---

[207] L.S.A.–R.S. 56:1452.

[208] L.S.A.–R.S. 56:1453.

[209] See text at note 187, supra.

[210] L.S.A.–R.S. 30.4 (c).

[211] See definition of "Surface Waters," *Black's Law Dictionary*, Fourth Edition, p. 1762.

[212] Chandler v. Scogin, 5 La. App. 484 (1926).

[213] See Articles 660 and 661 in Appendix, infra.

> The universal rule in this state has been to construe the law so as to reconcile it with the interests of agriculture . . .; and where the work is done for the improvement of the property for agricultural purposes, we cannot conceive of its being ordered destroyed unless the person demanding its destruction shows that it will injure his property.
>
> The provisions of Article 661 of the Civil Code do not vest in the proprietor of an estate or in the estate through which a stream flows any right in the bed of the stream which is not a part of the estate nor in the water which falls upon other estates which may finally reach and become a part of the stream . . .; and if defendant chooses, he may prevent the water from coming into the drain . . ., and plaintiff could not have any case of complaint unless he shows injury . . .

Although the court denied that the lower owner had any rights in the diffused surface waters appearing on the lands of the upper owner, and that the upper owner might prevent the water from entering the drain, it implied that there would be a cause of action if the lower owner could show injury. It was contended that the diversion of the water into another drain caused flooding of lower lands, but the court refuted this. What other types of injury might furnish a basis for a cause of action was not made clear. It is problematical whether a lower owner would be entitled to a certain portion of the diffused surface waters from the upper owner's lands for purposes, for example, of irrigation, if he could show that his crops were being injured by the deprivation of the waters. At any rate, the court made it clear that the lower owner was not entitled as a matter of right to any of the water in the absence of injury. Furthermore, this case did not actually involve the withholding of surface waters, but, rather, the diversion of water away from a drain so that the water reached the lower estate at a point other than the one it would normally have reached. Thus it was essentially a drainage rather than a "right to use" case. In view of this it is probable that the decision should not be given a great deal of weight regarding rights of use.[214]

It will be recalled that the State Supreme Court has indicated for particular purposes that streams that only flow during rainy seasons or that do not have well-defined banks may nevertheless be considered natural watercourses. In one case, however, a body of water lying in a swamp forming a part of a so-called shallow lake that conveyed water sometimes one way and sometimes another and depended for its existence on rainwater or overflow from streams, was considered a mere slough, not a stream.[215] It is problematical whether the courts might treat certain shallow bodies of water, although not classed as nor connected with a stream, as shallow lakes or bayous to which riparian rights might attach.[216] It would seem that, to be so treated, they would need at least to have poorly defined banks.

---

[214] It may be noted that this case was decided not by the State Supreme Court but by a Court of Appeal. Under the 1921 Constitution, the Supreme Court is the highest court and has been the court of last resort in the state in this and many other kinds of civil suits when more than $2,000 is involved. However, under a constitutional amendment approved by the voters in 1958, decisions of the intermediate courts of appeal (increased from 3 to 4) apparently now will generally be unappealable in most cases (see La. Const. of 1921, Art. 7, secs. 10, 20, and 29 as amended by S. B. Bill 128, 1958), although the Supreme Court may still decide questions of law on the request of any court of appeal (Const. 1921, Art. 7, sec. 25).

Although there is little authority as to the right of an upper owner to prevent diffused surface waters from reaching the lower estate, there is a great deal of law concerning his right to dispel such waters from his estate. The basic Civil Code provision (Article 660) relating to this subject reads as follows:

> It is a servitude due by the estate situated below to receive the waters which run naturally from the estate situated above, provided the industry of man has not been used to create that servitude.
>
> The proprietor below is not at liberty to raise any dam, or to make any other work, to prevent this running of the water.
>
> The proprietor above can do nothing whereby the natural servitude due by the estate below may be rendered more burdensome.

The last paragraph of this provision determines the rights of the upper estate owner in regard to drainage of surface waters from his lands. Taken literally, this paragraph might be interpreted to mean that the waters must be left to drain at their own speed and in their own course, without being speeded up or rechanneled by the upper landowner. It is clear, however, that generally the court will construe the paragraph liberally in favor of the upper owner,[217] so that a certain amount of drainage works necessary to the proper cultivation and to the agricultural development of his estate may be constructed. In determining the amount of drainage construction to be allowed, the court has stated the following rules to be applicable:

> The owner of the superior estate may make all drainage works which are necessary to the proper cultivation and to the agricultural development of his estate. To that end, he may cut ditches and canals by which the waters running on his estate may be concentrated, and their flow increased beyond the slow process by which they would ultimately reach the same destination.
>
> But the owner of the superior estate cannot improve his lands to the injury of his neighbor, and thus he will not be allowed to cut ditches or canals, or do other drainage works by which the waters running on his lands will be diverted from their natural flow, and concentrated so as to flow on the lower lands of the

---

[215] See *Natural Watercourses, Definition,* supra.

[216] See *Natural Lakes and Bayous,* infra.

[217] Guesnard v. Bird's Ex'rs., 33 La. Ann. 796 (1881); Chandler v. City of Shreveport, 169 La. 52, 124 So. 143 (1929); State ex rel. Wood v. Pinder 41 So. 2d. 479, 485 (La. App. 1949).

> adjacent estate at a point which would not be their natural destination, thus increasing the volume of water which would by natural flow run over or reach any portion of the lower adjacen estate, or to drain over his neighbor's lands stagnant waters fro his, and to thus render the servitude due by the estate below mor burdensome.[218]

In practice, it may be difficult to determine in a particular fact situation whether a particular drainage is or is not allowable.[219]

With respect to the application of the above-quoted Civil Code Article 660 to the obstruction of drainage by a lower landowner, th court in 1852 said that every low place in a field which might drai rainwater from above was not to be considered as a "natural drain, even though it might run through adjacent estates.[220] The court sai that, in the best interests of agriculture:

> When the low places in a field are not too deep to be draine by the system of draining now in general use, they become a par of the field, and cease to be natural drains.

It noted further that:

> There are, no doubt, cases in which the drainage . . . is interrupte by bayous and deep coulees, which the proprietor of the lowe estate is bound to keep open . . .

Nevertheless, in a later case in which the court enjoined the obstruction of natural drainage by a lower owner, held to be in violation o Article 660 of the Code, this drainage consisted of no more than th scattered flow of rainfall water across lower land having only a fe inches less elevation.[221]

---

[218] Ludeling v. Stubbs, 34 La. Ann. 935, 937 (1882). In an earlier case, th court noted that early grants of land in Louisiana were made with the conditio "that the land should be cultivated . . ." This, the court said, implied "the righ to drain them to the rear . . ." which was the natural direction of drainage, ". . . b means of ditches . . ." — but the right should be exercised so as to cause no unnecessary injury to others. Becknell v. Weindhal, 7 La. Ann. 291, 292 (1852).

[219] On the question of the possibility of increasing the burden of the natura servitude of drainage by the drainage of irrigation water from irrigated land, se Broussard v. Cormier, 154 La. 877, 98 So. 403, 405 (1923); Cornett v. Herbert, 31 So 2d. 446, 448-449 (La. App., 1947). The 1950 Census reported that 219,219 acre or more than 1/3, of the irrigated land in the state was artificially drained. 195 U.S. Census of Agriculture, Vol. III, Irrigation of Agricultural Lands, Part 8, Louisiana, State Table 2.

[220] Becknell v. Weindhal, supra, 7 La. Ann. 291, 292-293 (1852).

[221] Both the upper and lower landowners were rice irrigators. Broussard v. Cormier, 154 La. 877, 98 So. 403 (1923). See also Louisiana Irrigation and Mill Co. v Sixth Ward Drainage Dist., 158 La. 701, 104 So. 623 (1925), which is in genera accord. It may be noted that in the early Becknell case, supra, the court's decisio appears to have been influenced by the provision of an alternate drain and th plaintiff's long acquiescence in the lower owner's cultivation of the alleged natura drain.

Ground Waters

The authors have been unable to discover any reported cases in Louisiana dealing with rights to waters lying beneath the surface of the earth. The Louisiana Civil Code provisions that would appear to be most applicable to such rights are the following:[222]

> Article 491. Perfect ownership gives the right to use, to enjoy and to dispose of one's property in the most unlimited manner, provided it is not used in any way prohibited by laws or ordinances.
>
> Article 505. The ownership of the soil carries with it the ownership of all that is directly above and under it.
>
> The owner may make upon it all the plantations, and erect all the buildings which he thinks proper, under the exceptions established in the title: *Of Servitudes.*
>
> He may construct below the soil all manner of works, dipping as deep as he deems convenient, and draw from them all the benefits which may accrue, under such modification as may result from the laws and regulations concerning mines and the laws and regulations of the police.
>
> Article 666. The law imposes upon the proprietors various obligations towards one another, independent of all agreements; and those are the obligations which are prescribed in the following articles.
>
> Article 667. Although a proprietor may do with his estate whatever he please, still he cannot make any work on it, which may deprive his neighbor of the liberty of enjoying his own, or which may be the cause of any damage to him.
>
> Article 668. Although one be not at liberty to make any work by which his neighbor's buildings may be damaged, yet every one has the liberty of doing on his own ground whatsoever he pleases, although it should occasion some inconveniences to his neighbor.
>
> Article 2315. Every act whatever of man that causes damage to another, obliges him by whose fault it happened to repair it. . . .

Although none of these articles has been interpreted in any case concerning rights to waters, they have been discussed in what are perhaps analogous cases concerning rights attaching to underground gas and oil. In Higgins Oil and Fuel Co. v. Guaranty Oil Co. (1919)[223] the plaintiff had sunk an oil well on his land,[224] and was drawing oil therefrom by means of a pump when defendant sank a well on its land approximately 400 feet from plaintiff's well. The defendant's well proved to be a nonproducer and was abandoned, but by some means of underground communication it let air into the area affected by the plaintiff's pump, consequently reducing the production markedly.

---

[222] Although Griffin v. Mares, 54 So. 2d. 838 (La. App., 2d. Cir.) 1951 dealt with the construction of an agreement for joint use of a water well. The court held that the plaintiff had not been prevented from making use of his one-half interest in the well which was located on or along the property line between adjoining properties.

This well in Evangeline Parish pumps ground water for irrigation purposes

The plaintiff sought to have the defendant plug the open well to stop the flow of air. But the trial court held that the plaintiff had no cause of action, and the plaintiff appealed.

The Supreme Court noted in its reported decision that "subterranean or percolating waters" presented an analogous situation, and stated tha "In the civil law the right to drain off by means of a deeper well the subterranean water of the neighbor is well settled . . ."[225] The cour suggested that this would be so at least so long as there were no injury to the surface of a neighbor's land, such as drying it up. It also suggested that it would make no difference whether the withdrawal of water were accomplished by means of a pump or by relying on the natura flow or percolation of the water.[226]

---

[223] 145 La. 233, 82 So. 206, 5 A.L.R. 411 (1919).

[224] Apparently neither plaintiff nor defendant actually owned the tracts upon which they sank their wells, but merely held oil leases.

[225] 82 So. at 211. See also Ohio Oil Co. v. Ferguson, 213 La. 183, 34 So. 2d. 746 750 (1947). For a discussion of the view that caution should be exercised in drawing such analogies between water and oil or gas because of differences in their nature o use, see Summers, W. L., *The Law of Oil and Gas*, Vol. 1A, Sec. 62 (1954). In any event, it should be borne in mind that the withdrawal of oil and gas, unlike water has been made subject to considerable regulation by a state agency since 1940. See L.S.A.—R.S. 30.1 et. seq. This may include the establishment of drilling units and pooling arrangements.

[226] 82 So. at 211, citing New York and Mississippi cases. The court has not defined percolating groundwaters, but they would seem, in general, to constitute such waters as seep or percolate through the ground and are not shown to be confined in any definite underground watercourse.

The court went on, however, to discuss the effect of the above-quoted Code articles on the case at hand, which involved oil wells. It reasoned as follows:

> This last article[227] can be but of little assistance in the case, for it applies only to a person who is at fault, or, in other words, who has committed, or is committing a wrong; and the question in the case is whether the defendant is 'at fault.'
>
> The provision of Article 667, that the owner may not make any work on his property 'which may be the cause of any damage to' his neighbor is found under the title of 'Of Servitudes,' and hence apparently is one of the exceptions to which Article 505 refers, and hence would seem to be a limitation upon Article 505.
>
> It is also apparently in direct conflict with the provision of Article 491 that 'ownership gives the right to enjoy and dispose of one's property in the most unlimited manner.' The line of demarcation between what an owner may do with impunity and what he may not do without incurring liability is drawn by Article 668 between what is a mere inconvenience and what causes a real damage. But this cannot be the meaning; for very evidently an owner cannot be debarred from the legitimate use of his property simply because it may cause a real damage to his neighbor. It would be contrary to the fundamental legal principle according to which the exercise of a right cannot constitute a fault or wrong, and besides, every damage is real; an unreal damage cannot be a damage.[228]

Thus, the mere fact that the plaintiff had been injured in this case did not necessarily give it a cause of action against defendant; for, as defendant had a right to make works upon his own land, the exercise of that right could not constitute a fault or a wrong. After review of the French authorities on this subject, however, the court concluded that such cases as this should not be decided by any inflexible rule, but should be guided by two general principles: (1) that the owner must not injure *seriously* any right of his neighbor, and (2) even in the *absence* of any right on the part of the neighbor, he must not in an unneighborly spirit do that which while of no benefit to himself causes damage to the neighbor.[229] It is on this latter point that the court apparently decided the case in favor of the plaintiff. As defendant was obtaining no utility from the well and was injuring plaintiff, the court held that plaintiff had shown a cause of action.[230]

In two cases involving waste of gas (a gas well had "blown out"), the court has said that adjoining landowners would not be able to complain of the depletion of the portion of the gas reservoir lying beneath their lands, if the depletion had been caused by the depleter's taking the gas for a useful purpose.[231] (But in a later case, the court quote approvingly its prior reference in the above-discussed Higgins Oil an Fuel Co. case to a U. S. Supreme Court case in which the owner o one of the tracts of land overlying an oil and gas basin "was restraine from wasting the gas, even though his doing so was for the—to him useful purpose of lifting the oil to the surface."[232])

---

[227] L.S.A.—Civil Code, Art. 2315. (Authors' footnote.)

[228] Higgins Oil and Fuel Co. v. Guaranty Oil Co., 145 La. 233, 82 So. 206, 207, 5 A.L.R. 411 (1919).

[229] Id. at 82 So. 211

[230] Id. at 82 So. 212

If the gas is being wasted, as in the two cases involved, the adjoinin owners can obtain an injunction to prevent the waste, but still canno obtain money damages unless negligence or willful wastage can b shown.[233]

The court has sometimes referred to the "coequal" or "correlative rights of the owners of lands overlying oil and gas fields, and has mad the statement that:

> The rights of the several owners of the gas field are coequal; on owner cannot exercise his own right so as to preclude his neighbo from exercising his, or so as to interfere with the neighbor.[234]

But the court also has referred to the ability of one to withdraw a undue proportion to the detriment of the others, in the absence o regulatory legislation.[235] (Legislation relating to oil and gas wells i embodied in L.S.A.—R.S. 30:1, et seq.)

It should again be emphasized that none of these cases involve water or water rights, and that if the court were faced squarely wit a case concerning percolating ground waters, it might depart from th language of the above cases. Nevertheless, in view of the court's em ployment of an analogy to ground water in the Higgins oil case, dis cussed above, the court might also analogize in the opposite directio and apply principles in percolating ground water cases similar to thos which it applies to oil and gas cases.

There would appear to be no way of determining at presen whether a distinction may be made between different forms of groun waters and the rights connected to them. It is possible that differen rights may attach to waters considered to be percolating ground waters in contrast to underground streams, or underground waters flowing in conjunction with a natural above-ground stream. In other states where such questions have arisen, the appellate courts have usually held or said that the underground streams and underflows of surface watercourses are governed by about the same rules of law that apply to surface watercourses, but that all groundwaters will be presumed to be percolating waters rather than in an underground stream unless some evidence to the contrary is presented to the court.[236] Perhaps this distinction will be made also in Louisiana, but there is no indication from the court as yet that it will be made.

---

[231] Louisiana Gas and Fuel Co. v. White Bros., 157 La. 487, 143, So. 383, 85 A.L.R 1147 (1932).

[232] Hunter Co. v. McHugh, 202 La. 97, 11 So. 2d. 495, 505 (1942).

[233] McCoy v. Arkansas Natural Gas, 175 La. 487, 143 So. 383; 184 La. 101. 165 So 632 (1936); 191 La. 332, 185 So. 274 (1938); 4 A.L.R. 2d. 205-206.

[234] Higgins Oil and Fuel Co. v. Guaranty Oil Co., supra, at 82 So. 212; Hunter Co. v. McHugh, 202 La. 97, 11 So. 2d. 495, 502, 505 (1942).

[235] Hunter Co. v. McHugh, supra, at 11 So. 2d. 502 and 503.

In a recent Federal case involving a Louisiana situation, the court held (citing Louisiana cases) that "there is no legal duty or obligation on the part of land owners to refrain from engaging in the lawful production of gas from their own lands, notwithstanding the fact that such production may cause drainage from sands underlying adjoining lands." Billeaud Planters v. Union Oil Co. of California, 245 F. 2d. 14, 19 (1957).

In any event, the Louisiana court has held that the drilling of a well on one's own land which descends at an angle so as to reach beneath another's land constitutes a trespass and is not permissible. Gliptis v. Fifteen Oil Co., 204 La. 896, 16 So. 2d. 471, 474 (1943).

Natural Lakes and Bayous

Rights regarding the use of the waters of natural lakes and bayous appear to be unsettled.

There are no reported Louisiana Supreme Court decisions specifically concerned with rights to use waters from natural lakes and bayous. In 1925, however, the Second Circuit Court of Appeal of Louisiana decided a case concerning rights to the waters of a bayou which the court felt was probably not a running stream.[237] The bayou was not navigable; it was about 2,000 feet long and 100 feet wide. The plaintiff owned land on one side of this bayou, and sought an injunction to prevent the defendant from taking water from the bayou for purposes of irrigating his lands, which drained into but did not adjoin the bayou. The defendant was taking the water under a contract entered into with the person who owned the land between his land and the bayou, on the opposite side of the bayou from the plaintiff. The contract purported to authorize him to pump the water and convey it across the intervening land.

The trial court granted the injunction. But the Court of Appeal reversed this judgment on the grounds that plaintiff did not show that he would be damaged by the taking of water, in that he did not show how much water would be pumped, nor that plaintiff desired the water other than for fishing and to maintain the market value of his land, nor that defendant's pumping of water would kill any fish or have any appreciable effect on the bayou except in extremely dry seasons. Under the general rule of law that an injunction would not be issued unless actual or impending damages are shown, the injunction was denied. The court added: "However, plaintiff's right to renew the action, should necessity for it arise, should be reserved." But the court did not otherwise discuss how the body of water should be classified, nor did it discuss what difference it would make if the bayou had been a running stream, nor any question of riparian rights or use of water on nonriparian land.

---

[236] 55 A.L.R. 1386, 109 A.L.R. 415.

[237] Jackson v. Walton, 2 La. App. 53 (1925), 55 A.L.R. 887. Also see earlier discussions of this case under *Natural Watercourses: Definition*, and *Nonriparian Use*.

It is possible that not a great deal of weight should be put on th
case since (1) it was never clearly established that the bayou was no
a stream, and (2) the only rules of law expressed by the court were thos
pertaining to injunctions rather than water rights as such.[238] But th
case does support the proposition that a riparian owner cannot enjoi
the taking of water from a nonnavigable, nonflowing body of water b
a nonriparian landowner under a contract with a riparian owner, wher
no actual or impending damage is shown. It is doubtful whether th
holding should be extended beyond this to include any broader stat
ment of riparian rights.[239]

L.S.A.–R.S. 9:1101 declares the waters of all bayous, lagoons, lake
and bays not under the direct ownership of any person on August 1
1910, to be the property of the state.[240] Unlike the waters in rivers an
streams, which always have been insusceptible of private ownership ur
der Article 450 of the Civil Code relating to running water,[241] it woul
appear that there is no Code restriction that would have made th
waters in lakes and bayous (other than such as might be classed a
"running water") insusceptible of private ownership. The implicatio
of the statute is, in fact, to the contrary—that such waters may be pr
vately owned. If they are susceptible of private ownership, it seem
possible that Article 505 of the Code would place this ownership of th
water in the person owning the soil beneath the waters.[242]

The ownership of the beds of all navigable lakes was vested in th
state on its admission into the United States in 1812.[243] By the terms c
the 1921 Constitution, the state cannot now transfer title to the beds c
navigable waters except for reclamation purposes,[244] but prior to 192
there was no such restraint. In the 1954 case of California Co. v. Price,[2
the court held that any beds of navigable lakes or bays could have bee
transferred by the Legislature to private individuals prior to 1921, an
that, under a prescriptive statute of 1912,[246] the state could not attac
those transfers in the 1954 case even though the public policy of th
state is probably contrary to such transfers.[247]

---

[238] Also recall earlier discussion in note 214 about this being a decision of
lower appellate court, not the Supreme Court.

[239] It would seem that for riparian rights to attach to a shallow nonflowing bayo
or lake it would need to have at least poorly defined banks, as discussed earlier und
Diffused Surface Waters.

[240] See Appendix, infra.

[241] See Appendix, infra.

[242] See text at notes 53 and 54, supra.

[243] California Co. v. Price, 225 La. 706, 74 So. 2d. 1, 2 (1954). But see qualificatic
in note 109, supra. The State Supreme Court has indicated that the state's ownersh
of the bed of a navigable lake generally extends to the high-water mark. Roy, Inc.
Bd. of Comm'rs, Pontchartrain Levee District, 237 La. 541, 111 So. 2d, 765, 768, (195

[244] L.S.A.—Const. of 1921, Art. 4, Sec. 2. See text at note 105, supra.

[245] 225 La. 760, 74 So. 2d. 1 (1954).

[246] L.S.A.—R.S. 9:5661. See note 106, supra.

[247] California Co. v. Price, 225 La. 706, 74 So. 2d. 1, 11-14 (1954).

There was little discussion by the court in this case regarding what effect private ownership of the bed might have on the right to use the overlying waters. It did recognize that the ownership of beds would be subject to the superior rights of the government and the public to the "unhampered use of the water above them for navigation, commerce, fishing and the like."[248] What "and the like" might mean is difficult to determine.

A strong dissenting opinion (the case was decided by a 4 to 3 vote) deals with the problem created by considering the effect of L.S.A.–Civil Code, Article 505, which states that "The ownership of the soil carries with it the ownership of all that is directly above or under it," on the granting of private ownership of the bed.[249] The dissent maintains that Article 505 gives complete ownership of the waters to the owner of the bed, and that if the bed is placed in private ownership the state can have no legal claim to the use of the waters.[250]

It may well be, however, that waters in navigable lakes may be held to be insusceptible of private ownership despite the lack of any codal provision declaring this to be the case, as has been held with respect to underground oil and gas.[251] The question of rights to reduce the water to possession, and what effect the ownership of the bed might have on this right, might then be involved.

The following questions then are left undecided:

1. Are the waters of navigable lakes susceptible of private ownership?
2. If they are, does their ownership accompany ownership of the beds?
3. If so, what rights in the waters are reserved to the state and the public?
4. If the waters of lakes are insusceptible of private ownership, does ownership of the beds provide the right to reduce the waters to possession?
5. If there is such a right to reduce to possession, is it subject to other rights of other individuals, or the state and public?
6. In any case, what are the rights of a shore owner as opposed to a bed owner, where the owners are different individuals?

As can be seen, despite the court's holding that the beds of navigable lakes are susceptible of private ownership, very little has been clearly decided as to the rights to the water itself.[252]

---

[248] Id. at 74 So. 2d. 11.

[249] Id. at 74 So. 2d. 23-24. This problem was not directly dealt with by the majority opinion.

[250] Id. at 74 So. 2d. 24.

[251] See *Ground Waters,* supra.

[252] See Doiron v. O'Bryan, note 130, supra, where riparian rights in a navigable lake were discussed. But the case dealt only with the question of ownership of formerly submerged land adjoining the lake. See also Haynes v. Smith, discussed in note 308, infra.

It appears to be unquestioned that the beds of nonnavigable lakes are susceptible of private ownership.[253] (Whether a particular riparian owner owns any part of the bed depends on the circumstances.[254]) It is not clear, however, whether ownership of the bed carries with it the rights to exclusive use of the water of the lake or bayou. It would seem likely that if one person owns all the land surrounding a nonnavigable lake, which is not connected with any other body of water, and also owns its bed, he would be entitled to an exclusive use of its waters,[255] but many problems might arise where ownership of surrounding lands and the beds are in more than one person. Perhaps some form of apportionment with respect to the withdrawal of water would be in order in a situation in which two or more owners hold different lands adjoining a lake, but it is difficult to guess how a conflict between a person owning the shore of a lake and another person owning the bed might be resolved. On the one hand, Article 505 perhaps places ownership and control of the waters in the owner of the bed,[256] but on the other, the court has indicated that the owner of land on the shore of a lake has "riparian rights."[257] Also difficult to determine is the effect of ownership of beds and banks on the rights to use the water for fishing, hunting, etc.[258]

Some lakes or bayous may be considered a part of or connected with a flowing stream or river. Such lakes or bayous have been discussed earlier.[259] In one case, the court noted that:

> Bayous not only serve to supply estates with water, but they also serve as channels through which estates are drained, and they may in particular cases be 'floatable streams,' which serve as highways for the transportation of logs and other property. As natural drains, or 'floating streams,' many persons may be interested in them, so

---

[253] See California Co. v. Price, 225 La. 706, 74 So. 2d. 1, 10 (1954); State v. Sweet Lake Land and Oil Co., 164 La. 240, 113 So. 833 (1927); Realty Operators v. State Mineral Board, 202 La. 398, 12 So. 2d. 198 (1942); McDade v. Caplis, 154 La. 1019, 98 So. 625 (1923), 112 A.L.R. 1120.

[254] In the McDade case, supra, at 98 So. 626, the court indicated that a grant of land bordering on a nonnavigable lake did not include title to any of its bed, even though all the surrounding land was eventually acquired through such grants. But the Sweet Lake Land case, supra, suggests that a grant of land *entirely* surrounding a nonnavigable lake may include title to its bed without mentioning it. Here the state in three separate grants, but on the *same* day, had granted all the land surrounding the lake. See 113 So. 834 and 839.

See also State v. Aucoin, 206 La. 786, 20 So. 2d. 136 (1944) regarding shallow lakes whose beds were granted to the state as "overflowed land" in swampland grants by Congress.

If a nonnavigable bayou is considered a flowing stream, the grant of adjoining land ordinarily carries title to the bed. See Begnaud v. Grub and Hawkins, supra, note 39.

[255] See Realty Operators v. State Mineral Board, 202 La. 398, 12 So. 2d. 198 (1942)

[256] See text at notes 53 and 54, supra.

[257] Doiron v. O'Bryan, 218 La. 1069, 51 So. 2d. 628 (1951). See notes 130 and 252, supra.

[258] See note 66, supra, which has some bearing on this question.

[259] See particularly *Nature of Riparian Rights*: *Right to Use Water*; and *Natural Watercourses*: *Definition*.

that no one person can say as to a particular stream that there is united in him all the elements of perfect ownership. . . .[260]

Artificial Watercourses

It would appear that, under authority of various articles of the Civil Code,[261] an individual may construct entirely on his own land any canal, ditch, or other artificial watercourse which he may choose to make. But his rights connected with such works are less clear when such artificial watercourse connects with a natural body of water or otherwise affects the property or rights of other persons.

In 1885, a case arose concerning the rights of contiguous landowners on a canal to use the water flowing in the canal.[262] The plaintiff in the case had conveyed an undivided third interest in a sugar estate to the defendant, the conveyed estate being contiguous to plaintiff's estate. The conveyance contained a clause giving the plaintiff the right to get water from a lake or swamp in the front of defendant's estate and conduct it through defendant's estate back to plaintiff's estate. Another clause extended this right to plaintiff's estate itself, rather than merely to plaintiff personally, and described the canal which was to be used for transportation of the water. It further provided that the plaintiff's estate was to keep the canal free and open at all times, such that no damage to defendant's estate should occur from transportation of the water, and that defendant's estate should not obstruct the flow of the canal except for self-protection.

Plaintiff complained that defendant had placed two dams across the canal, was drawing off water from the canal, and was about to pollute the canal with sugarhouse skimmings. He sought to enjoin these actions.

The court in upholding the district judge's decision in favor of the plaintiff noted that a *predial servitude*[263] had been created by the contract and that the parties' rights in the canal waters were to be governed not only by the contract but also by the Civil Code provisions dealing with servitudes. As the contract specifically provided that the defendant could place no obstruction in the canal to prevent the water from running freely, it would seem that the dams placed in the canal by the defendant could have been ordered removed under authority of the contract itself. The court, however, went further and cited Articles 655, 660, 661, and 777 of the Code (since the parties had created a predial servitude) "which are to the effect that the owner of the estate which owes the servitude, can do nothing tending to diminish its use, or to make it more inconvenient."[264]

---

[260] Palmer v. Wilkinson, 141 La. 874, 75 So. 806, 810 (1917). For further discussion of this case, see note 52 and *Navigable Watercourses: Definition,* supra.

[261] See particularly Articles 491, 505, 667 and 668, quoted under *Ground Waters,* supra.

[262] Shaffer v. State National Bank, 37 La. Ann. 242 (1885). Another case, in 1959, involved the construction of a right-of-way agreement regarding the construction and use of a canal for the irrigation of rice. Kingery v. Reeves, 113 So. 2d. 64 (La. app., 1st ct.) 1959).

[263] That is, a servitude due one estate by the other, rather than a mere *personal* servitude between the parties.

It stated that:

> The law on this subject has been judicially expounded by this court in a number of cases, particularly in that of Ludeling v Stubbs,[265] [Authors' footnote] in which, after a review of the jurisprudence, it was declared that dams illegally obstructing a flow of water to the prejudice of one of the contiguous proprietors or owners, was a nuisance, which the law would order to be abated.[266]

After citing nine other Louisiana cases to this point,[267] the court continued:

> In the present case, it is therefore clear that the dams complained of and which arrested the water, were illegal obstructions, and that the plaintiff cannot be required to endure them, *unless for a time in cases of unavoidable necessity,* of which there is no evidence in the present controversy. (Emphasis added.)

It would appear that the court felt that in certain circumstances obstruction of the flow would be allowed.

As to the diversion of water from the canal, the court held that an unjustified withdrawal would not be allowed. It expressly provided however, that the defendant might use the water in a cross ditch on his estate for supplying his sugarhouse, cultivating and developing his estate, and for any other purposes; provided he did not thereby *unnecessarily* divert the flow of the canal, or cause any permanent injury to the plaintiff which might *seriously* impair his right to draw water through defendant's land citing Article 661.[268] Apparently this would set up some form of a reasonable use test in determining the relative rights in and to the waters of the canal.

---

[264] Shaffer v. State National Bank, 37 La. Ann. 242, 248 (1885).

L.S.A.—Civil Code, Art. 777; "The owner of the estate which owes the servitude can do nothing tending to diminish its use, or to make it more inconvenient."

"Thus he cannot change the condition of the premises, nor transfer the exercise of the servitude to a place different from that on which it was assigned in the first instance . . ."

L.S.A.—Civil Code, Art. 655: "One of the characteristics of a servitude is, that it does not oblige the owner of the estate subject to it to do anything, but to abstain from doing a particular thing, or to permit a certain thing to be done on his estate."

Articles 660 and 661 are included in Appendix, infra.

[265] 34 La. Ann. 935 (1881).

[266] 37 La. Ann. at 248, 249. It would appear that the court has somewhat expanded the actual holding in Ludeling v. Stubbs, which dealt solely with the right of an upper owner to cut ditches on his lands and thus divert surface waters onto the lower owner's lands in a manner in which they would not naturally flow, and of the right of *lower owner* to obstruct by dam the drainage of the *upper estate.* There was no mention of the right of an upper estate owner to obstruct the flow that would reach the lower estate.

[267] As in Ludeling v. Stubbs, supra, none of the cited cases were directly in point.

[268] Shaffer v. State National Bank, 37 La. Ann. 242, 248 (1885).

The threatened pollution of the water by defendant was not enjoined by the court under the Code nor under the express provisions of the contract, but rather by inference from the contract, on the reasoning that to allow pollution would be destructive of the privilege granted plaintiff to draw water for useful purposes.[269]

This case would seem to indicate that the servitude provisions of the Civil Code are applicable to artificial watercourses where the parties contract expressly or impliedly for this to occur. In effect, the court treated the canal as a natural watercourse, at least as between the two estates involved. It is probable, however, that because of the existence of the contract between the parties, the case should be limited to its particular facts as authority.

Navigation canals may be constructed on one's own lands, and a toll charged for their use even without a franchise from the Legislature.[270] Domestic corporations organized for the purpose of building navigation canals have the power of expropriation for rights of way for such canals,[271] if the corporations file with the Louisiana Secretary of State a resolution agreeing to be public utilities,[272] and the estimated cost of construction exceeds $3,000,000.[273] They are also given right of way over public lands.[274] The Commissioner of Wildlife and Fisheries is authorized to acquire by lease, purchase, or expropriation any canals situated in the coastal parishes useful to the seafood industry, and to operate them so that they are open to free navigation by all vessels.[275]

The construction, improvement, and maintenance of navigation canals, and the acquiring of property for such purposes, including the acquiring of adjoining property for industrial development (but no part of which shall be more than one-half mile from the center of such canals) are declared to be works of public improvement, the titles to which are to vest in the public and for public purposes.[276]

The municipalities, as well as the parishes, are authorized to acquire property for carrying out the above-mentioned public purpose, by expropriation, if necessary. This authority exists in the case of municipalities whether the works are within or without their corporate limits.[277]

Under the state Constitution, the Legislature is empowered to create navigation districts as political subdivisions of the state for the purpose of obtaining, improving, and maintaining navigation on rivers an streams.[278] Pursuant to this, the Legislature has created a few such di tricts.[279]

---

[269] Id. at 249.

[270] Harvey v. Potter, 19 La. Ann. 264, 92 Am Dec. 532 (1867). Ilhenny v. Broussard, 135 So. 669, 172 La. 895 (1931).

[271] L.S.A.–R.S. 45:64.

[272] L.S.A.–R.S. 45:70.

[273] L.S.A.–R.S. 45:71.

[274] L.S.A.–R.S. 45:66; L.S.A.–R.S. 34:346.

[275] L.S.A.–R.S. 34:341.

[276] L.S.A.–R.S. 34:361. Just how this provision can be reconciled with the court holdings that navigation canals can be privately owned and operated (supra) is difficult to determine. Perhaps this provision is merely an authorization for public ownership, rather than a mandate.

[277] L.S.A.–R.S. 34:362.

Any canal or other artificial waterway constructed by a levee di trict, which is navigable in fact and connects with any other navigabl waters, may be dedicated and declared by the governing authority o the levee district with the approval of the Department of Public Work and concurrence of the United States district engineer, as a waterwa subject to free and unrestricted navigation by the public.[280]

Prescription

It would appear that a riparian owner's right to use running wate granted by L.S.A.—Civil Code, Article 661[281] cannot be terminated b nonusage or failure to exercise the servitude, for the Code explicit states that:

> Prescription for nonusage does not take place against natural o necessary servitudes, which originate from the situation of places.[2

The servitude created by Article 661 appears to be such a servitude.

Although a riparian owner apparently cannot lose his rights to wat given under Article 661 through nonusage, there is the possibility that h may lose these rights through other means, such as adverse use, implie acquiescence, or a conflicting acquired servitude.

The court has given some slight indication that the natural serv tude of drainage due the upper estate by the lower, by virtue of Articl 660 of the Code, might be lost under certain circumstances. In a cas in which the lower owner had filled in a shallow depression in his fiel such that waters from the upper estate could not use this depression a a means of escape from the upper estate, the court indicated that on of its reasons for refusing to compel the lower owner to remove th obstruction was that the obstruction had been made openly and i the presence of the upper owner without complaint from the uppe owner. This implied acquiescence in the existence of the works over period of years amounted to a waiver of his right to complain.[283]

As the right of natural drainage is a natural servitude arising fro the situation of places, it would seem that the above-quoted Code pro vision forbidding prescription against such servitudes might not b applicable when there is a waiver of a servitude. It should be note however, that the court placed a great deal of emphasis on the interests of agriculture in this case, and could have decided it solely on the grounds that Article 660 of the Code calls for a liberal construction in the interests of agriculture[284] That is, it is possible that the upper owner had never had a right to that particular drainage under Article 660, and thus had no right which he could waive.

---

[278] L.S.A.—Const. of 1921, Art. 14, § 30.3 (1921).

[279] L.S.A.—R.S. 34:401 et. seq.

[280] L.S.A.—R.S. 38:291.

[281] The article begins: "He whose estate borders on running water may use it a it runs . . ." See Appendix, infra, for complete article.

[282] L.S.A.—Civil Code, Art. 795. In contrast, conventional servitudes may be e tinguished by nonusage during 10 years. See L.S.A.—Civil Code, Art. 789, and cas noted thereunder.

[283] Becknell v. Weindhal, 7 La. Ann. 291 (1852).

Although the riparian right to use water apparently cannot be lost by nonuse, it is not clear whether it might not be *acquired* by a continuous and apparent use for a period of 10 years.[285] L.S.A.—Civil Code, Article 765 provides that "continuous and apparent servitudes may be acquired by title, or by a possession of ten years."[286] It would seem that something of a conflict might arise in applying the two servitude articles.

---

[284] The lower owner in this case had provided an alternative drain, so that apparently the upper owner's ability to cultivate his fields was not greatly affected. Thus, on balance, the total benefit to agriculture was probably maximized by allowing the drain to be closed.

[285] No cases were found that dealt with the acquisition of a servitude to use water when it could be said that the use was continuous and apparent. L.S.A.—Civil Code, Article 727 defines continuous servitudes as "those whose use is or may be continual without the act of man." Aqueducts, drains, and views are cited as examples. Discontinuous servitudes are defined as "such as need the act of man to be exercised." Rights of drawing water, passage, and pasture are cited as examples. Article 724 states that "The conducting of water or aqueduct is the right by which one conducts water from his estate through the land of his neighbor by means of an aqueduct or ditch." Article 720 states that "The right of drawing water is a servitude by which one suffers his neighbor to draw water from the well or spring he has on his land . . ." The right is generally limited to the use of those living in his neighbor's house. From the foregoing general distinction drawn between continuous and discontinuous servitudes, however, it seems probable that any ditches, canals, *or other structures or devices* that would *not* require "an act of man" for their operation, which are physically apparent and continuous, and which serve to bring water upon one's estate could create through prescription a servitude that would entitle the recipient estate to their continued enjoyment. But in a number of cases, a servitude created through prescription, such as to convey water through a ditch across another person's land, may not include any rights to use the source of the water. In any event, it is problematical whether rights to use a natural watercourse could be acquired through prescription so as to impair the natural servitude of riparian landowners under Article 661, as indicated above.

The pertinent Code articles appear to be derived from French and Spanish sources. *Project of the Civil Code of 1825, 1 Louisiana Legal Archives* 78 (1937); 15 La. Law Rev. 777, 779 (1955). ". . . An aqueduct conveying water from a fountain which rose in another's field . . ." was recognized as an example of a servitude that could be acquired by prescription in Spanish law. Las Siete Partidas 3.31.15; *The Laws of Las Sieta Partidas* 416 (Moreau-Lislet & Carlton Translation 1820). In one early case, the Supreme Court indicated that the use of a neighbor's well was not a continuous servitude but it did not describe the nature of such use. Durel v. Boisblanc, 1 La. Ann. 407 (1846). A lower appellate court, in a case involving a sewer line, indicated that continuous servitudes do not require unceasing operation. Fuller v. Washingon, 19 So. 2d. 730, 731 (La. App., 1944).

For a more complete discussion of the subject of acquisition of servitudes by prescription, see 15 La. Law Rev. 777 (1955).

[286] It should be noted, however, that L.S.A.—Civil Code, Article 3504 provides that "A continuous apparent servitude is acquired by possession and the enjoyment

If, for instance, an upper riparian owner were to divert water by means of a canal for a period longer than 10 years he might possibly acquire a servitude under Article 765. But a lower owner apparently cannot be deprived of his servitude to use water given by Article 661 because of nonusage. The question may well be raised as to whether the lower owner has lost his rights of use, to the extent that they are infringed, not by nonusage, but by allowing the upper owner to establish his servitude. In the absence of decided cases it is difficult to predict whether this approach would be followed.[287]

Incidentally, it may be noted that L.S.A.–R.S. 9:1251, enacted in 1958, provides that if any landowner "expressly or tacitly" allows the public or certain persons to pass through or across his land solely for their convenient access to waters for boating or to any recreational site, they shall **not** thereby acquire a servitude or right of passage (nor shall it thereby become a public road or street by reason of a governing authority's maintaining or otherwise performing work thereon). However, this shall not prevent "land owners from entering into enforceable contracts specifically granting" such a servitude,[288] nor the specific dedication of roads or passages to public use, nor does it "repeal any laws creating servitudes along rivers, streams or other waters."[289]

Contrariwise, another statute provides:

> When private property is *damaged* for *public* purposes any and all actions for such damages are prescribed by the prescription of two years, which shall begin to run when the damages are sustained. (Emphasis added.)[290]

---

286 (*Continued*)
of the right for thirty years uninterruptedly, even without a title or good faith." Art. 765 has been interpreted to mean that 10 years' prescription will suffice to acquire a continuous, apparent servitude if good faith is present. Kennedy v. Succession of McCollam, 34 La. Ann. 568, 574 (1882). For a discussion of the case and the problems it dealt with, see 15 La. Law Rev. 777, 790, et seq. (1955). See also Randazzo v. Lucas, 106 So. 2d. 490 (La. App., 1958).

[287] In Sample v. Whitaker, 171 La. 949, 132 So. 511 (1930), the court held that a discontinuous mineral servitude in another's land, to drill for and remove minerals therefrom, may be extinguished, under particular circumstances, when the ownership of the land is acquired through prescription by the "holder of an apparently valid title for the whole property, in good faith, remaining in undisturbed possession of the land . . ."—although, under the circumstances, the minority of some of the owners of the servitude might suspend the operation of a statute providing for the loss of such a servitude through nonuse. However, the relevance of such a case to the question at hand is problematical.

[288] See note 145, supra, indicating that such enforceable contracts may be created by acts sufficient to transfer title.

[289] Nor does it repeal laws regarding expropriation of servitudes or authorizing the legislature or governing authorities to open, lay out, or appoint public roads or streets.

[290] L.S.A.–R.S. 9:5624. It has been held that this statute doesn't apply when property is taken, *but not damaged*, for public purposes. A. K. Roy, Inc. v. Bd. of Comm'rs, Pontchartrain, 237 La. 541 111 So. 2d. 765, 767 (1959). Also see discussion in this case of R.S. 9:5626 relating to appropriated lands used or destroyed for levees or levee drainage purposes. See also note 106, supra.

1958 Declaration of State Policy Regarding Surface Waters

In 1958, the State Legislature enacted an act which declared a policy of the state in regard to surface waters including the following:

1. The ownership and control of development and use of surface waters for all beneficial purposes are within the jurisdiction of the State which . . . may establish measures to effectuate the proper and comprehensive utilization and protection of such waters.
2. The constantly increasing needs of the people of the State for water requires that the surface water resources within the State be put to beneficial uses to the extent of which they are most reasonably capable and the waste and unreasonable use of surface waters should be prevented, and conservation of such waters should be accomplished to the fullest extent which is reasonably possible.
3. The public welfare and interest of the people of the State require the proper conservation, development, use, and protection of the inseparable land and water resources.[291]

In the same act, the Legislature provided for a temporary water resources study commission to study needed revisions in the water policy of the state and to develop recommended implementing legislation for the next regular session. (But the commission had not been activated as of April 1, 1959, and no appropriations had been made available for that purpose.) It noted that a careful, comprehensive study of surface water resources and related problems should be made by the state before enacting any additional water resources legislation, and added that:

> Nothing in this Act shall impair or interfere with the continuance of any existing valid rights to the use of surface waters, or to interefere with the customary use of water for domestic purposes.

In using the term "surface waters," the Legislature apparently was primarily concerned with waters in rivers, streams, and other bodies of water on the earth's surface.

State and Local Agencies or Organizations

Following is a description of some of the functions of various state and local agencies or organizations that have responsibilities and related powers concerning water resources.

It was noted in a recent report that:

> Including overhead and general expenses of the various state departments involved, the State is spending over $8,500,000.00 on

---

[291] La. Acts 1958, No. 363.

The State Department of Public Works is empowered to plan, construct, operate, and maintain dams, spillways, reservoirs, canals, locks, levees, drainage and irrigation systems, and other public works.

> construction, improvement and maintenance of various water installations for the biennium 1955-56. In addition to this, $3,840,000.00 has been allotted to the various parishes for drainage and road purposes.[292]

This report states also that large sums are being spent by special drainage, levee, and other districts, and by parishes, municipalities, and industry.

State Department of Public Works

This department is empowered to plan, construct, operate, and maintain "levees, canals, dams, locks, spillways, reservoirs, drainage systems, irrigation systems—inland navigation projects, flood control and river improvement programs—and other public works."[293] It may provide (and charge the reasonable cost of) engineering, economic, and other advisory services to local governmental subdivisions and special districts. It is also specifically authorized to plan systems of inland waterways and water conservation projects, to "foster the maintenance, improvement, and extension of the Intracoastal Canal System and its feeders and initiate, sponsor, and carry through to completion all waterway projects which will further develop and expand the water resources of Louisiana . . .," subject to the jurisdiction of the United States.[294] The department is required to confer with the State Wildlife and Fisheries Commission in the planning of projects affecting wetlands and other wildlife habitat—whether they are "joint state-federal, state-parish or state or parish projects."

---

[292] *Water Problems in the Southeastern States,* Research Report No. 5, Louisiana Legislative Council, April 7, 1955. Quotation is from summary. Also see pp. 42-44 of Dec. 1957 revision of this report (Research Study No. 11) regarding 1956 and 1957 appropriations by the state for various programs.

[293] L.S.A.—R.S. 38:1 et. seq.

In order to perform its functions relating to the planning and designing of various hydraulic projects relating to drainage, irrigation, and water conservation, the department collects and interprets basic data to appraise the state's water resources. Since 1942, the department has increased annually the amount of money allocated to its program of extensively collecting and publishing water-resources data collected in cooperation with the United States Geological Survey. Streamflow, water quality, and other surface and ground-water data are collected under this cooperative program. The State Geological Survey (discussed later) also contributes funds to this program for the collection of ground water data.

In addition to its general operating budget, the department from time to time, by special legislation, has been granted appropriations of state funds to expend for particular purposes. Frequently, this has been done to enable the department to assist with projects of local districts, such as by making surveys, developing plans, or constructing necessary dams or other facilities. Examples of such assistance are included later.[295]

State Stream Control Commission

This commission exercises regulatory powers to control pollution, as discussed earlier under *Pollution Control by Public*. It will be recalled that the commission consists of the Commissioner of Wildlife and Fisheries, the President of the State Board of Health, the Commissioner of Conservation, the Commissioner of Agriculture and Immigration, the Executive Director of the Department of Commerce and Industry, and the Attorney General, or their authorized representatives.[296]

State Board of Health

This board has jurisdiction over water supplies and waste disposal within the state for the protection of health. It is authorized and directed to adopt a sanitary code that will include regulations regarding these matters.[297] The regulatory powers granted to the Stream Contro Commission do not deprive the Board of Health of its jurisdiction in regard to matters that directly affect the public health.[298]

---

[294] It may be noted that to promote the development of navigation, the Legislature has also created various navigation districts, harbor and terminal districts, and port commissions or authorities. See L.S.A.–R.S. 34:1 et seq.

[295] See, for example, *Bayou D'Arbonne Lake Watershed District*, and *Fish and Game Preserves*, infra.

[296] L.S.A.–R.S. 56:1431 et. seq. See L.S.A.–R.S. 33:3881 et. seq with respect to sewerage districts and sewerage systems.

State Wildlife and Fisheries Commission

Some of the relevant functions of this commission are discussed late under the heading *Fish and Game Preserves.* The commission administers various laws relating to the protection, propagation, and taking o fish and game.[299]

Two identical statutes deal with the protection of fish. L.S.A.–R.S 56:321 and R.S. 56:361 provide that any person taking water from an of the fresh waters of the state for any purpose shall provide suitabl screens on intake pipes in order to prevent fish being removed fron the streams and destroyed or pumped out upon the land. The requirin and approval of such screens is under the judisdiction of the Wildlif and Fisheries Commission.[300] R.S. 56:321 is meant to apply to th protection of sport fishing, and R.S. 56:361 applies to the protection o commercial fishing.

The commission also exercises certain functions relative to the control of pollution, discussed earlier under the heading *Pollution Contro by Public.*

State Geological Survey

The Geological Survey, Department of Conservation, is empowere to make a geological survey of the entire state, and it may cooperat with others in doing so.[301] It has published a number of reports on surface and ground water resources. It is currently cooperating wit the State Department of Public Works and the U.S. Geological Surve in making investigations of water resources and uses in Louisiana.[302]

Police Juries

These are the governing bodies of the several parishes in the stat (which are comparable to counties in other states). These juries ar authorized, among other things, to:

(1) Regulate the construction and repair of dams and levees;

(2) Close and dam small canals or streams of water in the parisl that are not under the jurisdiction of the United States Gov

---

[297] L.S.A.–R.S. 38:11.

[298] L.S.A.–R.S. 56:1437.

[299] L.S.A.–R.S. 56:1 et. seq., and Const. of 1921, Art. 6, sec. 1 (A) (1921).

[300] If, on inspection, a technician determines that a screen over an intake pip is needed, the matter is taken up with those making the diversion, by the Commission's Division of Water Pollution Control, whose principal function is aquatic biological and chemical research. (Based on information supplied by Mr. K. E. Biglane Chief of the Division.)

[301] See L.S.A.–R.S. 30:201 et seq.

[302] See particularly their cooperative report entitled *Water: A Special Report t the Louisiana Legislature,* published by the Department of Public Works in 1956.

ernment and are found to be harmful to property or public health. However, the approval of the Department of Public Works (or any levee district in which the dam is located) must first be obtained and a public hearing held;

(3) Regulate the clearing of the banks of rivers and natural drains to secure free passage for boats, logs and timber;

(4) Build dams to prevent salt water from the Gulf of Mexico and connected waters from entering into fresh-water streams;

(5) Construct and maintain drainage ditches and canals, to open drains, and perform related functions, and to cooperate in any related state or federal program.[303]

In 1954, the Legislature specifically authorized the Police Jury of East Carroll Parish "to regulate the height and use of the waters of Lake Providence . . ."[304] The Police Jury of Vernon Parish is cooperating in a joint project with the State Department of Public Works and the Anacoco-Prairie State Game and Fish Preserve to impound a fresh water supply. (See *Fish and Game Preserves,* infra.)

Municipalities

Incorporated municipalities (cities, towns, and villages) have a variety of powers regarding water resources or water supply. Some have been included in the special legislative charters of those that have been created by this method. Other powers are included in general or other special legislation applicable to all or certain municipalities.

Examples of such powers include powers to operate water works and acquire necessary property rights for such purposes by purchase or expropriation.[305] Municipalities, as well as parishes, also may engage in such works of public improvement as the deepening and improvement of watercourses or construction of canals for navigation purposes and the acquiring of adjoining property for industrial development.[306] One or more municipalities, parishes, or special districts may by agreement jointly exercise a number of powers that they hold individually.[307]

The court in a 1941 case stated that the police powers of municipalities generally may not be exercised outside their limits even though they have acquired property outside. It said the Legislature may grant such powers by special acts but they are to be strictly construed. In this case the city of Shreveport had been granted regulatory powers regarding, and ownership of the bed of, a navigable lake outside its limits to provide an unpolluted city water supply.[308]

---

[303] L.S.A.—R.S. 33:1236 to 33:1238.

[304] Acts 1954, No. 514.

[305] See, e.g., L.S.A.—R.S. 33:361; 33:841.

[306] See L.S.A.—R.S. 34:361 and 34:362.

[307] Provided such agreements (1) do not affect designated types of private or semi-private activities, including water systems and flood control and drainage projects, and (2) do not constitute a donation of public funds or services of one municipality, parish, or special district for the benefit of another. L.S.A.—R.S. 33:1321 et. seq.

Irrigation Companies

The Louisiana Constitution of 1921 provides that:

"Corporations formed or to be formed . . . for the purpose of constructing and operating gravity canals for irrigation and navigation . . . shall have the right under such regulations as shall be prescribed by the Department of Public Works to utilize for such purpose the waters of the navigable streams . . . which may be the property of the state; . . ."[309] The term "corporation" includes "all joint stock companies or associations having any power or privilege not possessed by individuals or partnerships."[310]

It might be noted that L.S.A.–R.S. 9:1101 provides that no one is to be charged for the use of state waters.[311] As irrigation companies undoubtedly do charge persons who use the water they supply, it would seem that either the statute has been abrogated as to this provision or the companies are charging only for their services, not for the water.

The Legislature has provided that corporations formed to construct and operate canals for irrigation by gravity have power to acquire all land needed for rights of way and reservoirs either by negotiation with the owners of the land or by expropriation. The power of expropriation may not be used, however, within a township or section having a canal already in actual use unless consent is obtained from the owners of such canal.[312] The Legislature has further provided that not only may the waters of navigable streams be utilized by companies operating under this legislation but that "other waters of the State" may be so used, under regulations prescribed by the Department of Public Works "for the purpose of preventing unnecessary injury to private or public property."[313]

---

[308] By virtue of acts enacted in 1910, 1920, and 1926. (The regulatory powers also encompassed the area around the lake for a distance of 5,000 feet.) The court held that the city's ordinance prohibiting the operation of motor boats without mufflers on the lake was *ultra vires* and unenforceable because it had no relation to the city's regulatory power to prevent pollution of the lake waters. City of Shreveport v. Case, 198 La. 702, 4 So. 2d. 801 (1941). See City of Shreveport v. Wilkinson 182 La. 783, 162 So. 621 (1935), regarding the validity of an ordinance prohibiting boating on the lake at night. In a case decided by the Court of Appeals, 2nd Circuit the city's Commissioner of Public Utilities had authorized the defendant, a riparian owner, to build a boat house and pier on the lake for a commercial fish camp, but other riparians (who used the lake for their private boating and/or residential purposes) sought to enjoin its construction and use. The injunction was denied. (The court noted that the city had not adopted any regulations governing the construction of boat houses, piers, etc., nor had the defendant's property been zoned or made subject to any private restrictive convenants.) Haynes v. Smith, 85 So. 2d. 326 (1956)

Recall that the 1958 Uniform Pleasure Boating Act now prohibits the regulation of pleasure boating by local political subdivisions. See text at note 144, supra. Municipal corporations were called political subdivisions of the State in State v. Maitreiean, 193 La. 824, 192 So. 361 (1939).

[309] L.S.A.–Const. of 1921, Art. 13, § 6. (This provision also applies to hydroelectric power companies.) Such corporations are also granted "the right to use as reservoirs . . . the deserted beds of former navigable streams which may be the property of the State . . ." It is provided, however, that the property and plants of companies utilizing this authority shall become state property after 70 years from the completion of their canal systems or plants, "to be operated by it for public revenue in such manner as the Legislature shall direct . . ."—except for canals in existence before January 21, 1921.

[310] L.S.A.–Const. of 1921, Art. 13, sec. 8.

[311] See *Nature of Riparian Rights, Ownership of Water,* supra.

These provisions were embodied in Acts 1920, No. 43 which further provided that any such corporations formed after the act became effective were to be deemed public service corporations. Corporations in existence before the passage of the act do not fall within its provisions.[314]

An act passed 4 years prior to the 1920 act was similar and apparently is still in effect.[315] The major differences in the two acts appear to be that the earlier act:

1. Applies to corporations organized to build and operate not only irrigation canals, but also commercial navigation and hydroelectric canals;[316]
2. Does not explicitly grant to the corporations the right to utilize the waters of the state;[317]
3. Restricts the width of the right of way for the construction and laying out of canals to 600 feet;[318]
4. Requires that the corporations file with the Secretary of State a resolution agreeing that the corporations shall be public utilities before they can exercise the right of expropriation.[319]

There are a number of companies that furnish irrigation water in the state, particularly in southern Louisiana. In some instances, disputes regarding their undertakings to supply irrigation water to individual farmers have reached the Louisiana Supreme Court. But in none of the reported cases were rights to the source of the water used in dispute. In one case, however, the court noted that irrigation companies' rights of supplying irrigation water are subject to the condition that if "they should abuse their right to pump water from the public streams adjacent to their land, or to the land of those whom they contracted to supply water . . . to the prejudice of the rights of other individuals or corporations or of the state, the law would afford the injured party an adequate remedy."[320]

---

[312] L.S.A.–R.S. 45:61.

[313] L.S.A.–R.S. 45:62. It is not clear here whether "other waters of the state" refers to state-owned waters, or to all waters within the state.

[314] L.S.A.–R.S. 45:63.

[315] Acts 1916, No. 268. This is now L.S.A.–R.S. 45:64–45:71.

[316] L.S.A.–R.S. 45:64.

[317] L.S.A.–R.S. 45:64–45:71.

[318] L.S.A.–R.S. 45:66.

[319] L.S.A.–R.S. 45:70.

[320] State v. Riverside Irr. Co., 142 La. 10, 76 So. 216, 218 (1917).

In a case in 1907 the court ruled that, under the terms of a contract by a certain company to furnish water to a rice irrigator, the company could be held liable for failing to supply the water when properly requested to do so—except for a deficiency in supply of water at its source and certain other exceptions. But the company was held not to be liable because the irrigator had not given it a 10-day written notice that he wanted the water, as required by the contract.[321]

In an earlier case, the court held that under the terms of its contract a certain company was not liable for damages by failing to furnish irrigation water, when the failure was due to the inadequacy of rain that supplied a bayou. Conversely, as the farmers suffered almost a total los of their crops, they were not held liable for the stipulated rent.[322]

Irrigation Districts

The State Legislature is granted the power by the Louisiana Constitution to authorize the police juries of the various parishes to create irrigation districts, which may be composed of territory either wholly withir a parish, or partly within two or more parishes, and to authorize them within limitations, to incur debt and issue negotiable bonds to construc irrigation works.[323]

In pursuance of this constitutional authorization, the Legislature ha enacted laws allowing irrigation districts to be formed.[324] Under thes laws, the lands comprising one or more parishes or any portion or portions of one or more parishes may be formed into an irrigation district.[325] All land that cannot receive any benefit from operation of a irrigation district shall be excluded at the time the district is created.[32 The police juries do not initiate the action that creates a district, bu they must create a district when petitioned to do so by the owner of a majority of the acres of land within the limits of the propose district, outside corporate limits of incorporated towns and cities.[327] I the proposed district is composed of lands situated in more than on parish, the petition must be signed by the owners of a majority of the acres of land in each parish within the proposed district, and presented to the police jury of the parish having the largest number of acres in the proposed district.[328]

---

[321] Mathieu v. N. American Land & Timber Co., 119 La. 896, 44 So. 721 (1907) For other cases construing contracts of various companies to furnish irrigation wate see cases cited in Louisiana Digest, Waters, sec. 254, et. seq.

[322] Landers v. Garland Canal Co., 52 La. Ann. 1465, 27 So. 727 (1900).

It may be noted that legislation provides for a lien on irrigated crops to secur the agreed payment for the irrigation water supplied by another. L.S.A.—R.S. 9:452 (See also 9:4521.) Cases construing this statute include Ferre Canal Co. v. Burgi 106 La. 309, 30 So. 863 (1901), and Haas v. Ardoin, 145 So. 388 (La. App., 1933).

[323] L.S.A.—Const. of 1921, Art. 14, § 14 (d). The constitution limits the amoun of debt which the Legislature can authorize the districts to incur to 10 percent the assessed value of the taxable property within the district, except that an acreag tax, or forced contribution, not exceeding 50 cents an acre for a period not excee ing 40 years may be imposed by the district to support a bond issue not withi this 10 percent limitation. L.S.A.—Const. Art. 14, § 14 (f) (1921).

[324] Acts 1938, No. 415; L.S.A.—R.S. 38:2101—38:2123.

[325] L.S.A.—R.S. 38:2101 (B).

[326] L.S.A.—R.S. 38:2101 (C). (Added by Acts 1956, No. 462.) No criteria a provided for determining whether land will receive benefit, however.

[327] L.S.A.—R.S. 38:2102.

All irrigation districts are governed by a board of commissioners made up of five commissioners.[329] They are selected by the landowners of the district, and serve for a term of four years.[330]

Irrigation districts have broad powers and authority. They may conserve the fresh water supply of the state for the benefit of the inhabitants of the districts to provide water for irrigation and other uses, both within and outside their boundaries. They are corporations with all the powers and rights of a political subdivision of the state for the purposes of issuing bonds and incurring debt. They may sue and be sued, incur contract obligations, and perform any acts necessary and proper for the carrying out of the purposes and objects for which they were created. This includes the power to expropriate property.

The districts may acquire by any means necessary the properties needed for their suitable operation and may dispose of any properties owned to any body organized under the laws of the United States. They may contract and enter into agreements with the United States, or any person, firm, corporation, or political subdivision of the state. They may delegate to any body organized under the laws of the United States all powers conferred upon them by the state, to the fullest extent allowed by law. Also, they may coördinate their activities with state and federal flood-control works and navigation projects.[331]

Such districts may issue and sell revenue bonds for the purpose of constructing, acquiring, or improving an irrigation system and may furnish and supply water for this purpose. An irrigation district may acquire water from any other irrigation system, or from any other source, and distribute the water. It may "make a uniform rate for, and collect a charge for water" distributed to the users. This charge shall be in addition to any tax levied to pay on any bonds which are issued. No part of the money realized from the sale of bonds voted to construct irrigation systems, canals, or ditches shall be used to pay for waters so purchased.[332]

Any irrigation district may, when petitioned to do so by the owners of a majority of the acres of land in the district (outside of incorporated towns and cities), levy an acreage tax not exceeding 10 cents an acre for a period not exceeding 40 years, for the purpose of maintaining and operating the district.[333] All lands within the district (outside of incorporated towns and cities) shall be taxed. The fact that water from the natural or artificial waterways in the district is not used on certain lands does not exempt them from taxation.[334]

---

[328] Id. There would appear to be no limitation as to the minimum size of the district or the number of irrigators required, except for the provision that there must be five commissioners residing within the district. See footnote 198, supra.

[329] L.S.A.–R.S. 38:2107. Each must be a qualified elector of Louisiana, reside within the district, and own lands in the district of an assessed value of $2,000, or represent a corporation owning lands of this value within the district.

[330] L.S.A.–R.S. 38:2102; L.S.A.–R.S. 38:2108.

[331] See also note 139, supra, regarding an applicable 1958 constitutional amendment.

[332] L.S.A.–R.S. 38:2112.

This last provision of the law was added in 1956. It appears that, although the basic law was enacted in 1938, no irrigation district was formed until after the 1956 amendment. This may have been due at least in part to the provision of the original 1938 act that lands which do not receive "benefit from the operation of an irrigation district" and "which do not use water from natural or artificial waterways within the district" could not be taxed. Apparently, this would have made it difficult to sell bonds, because often there would be inadequate assurance that enough money would be forthcoming to pay the obligations.[335] Apparently to remedy this situation, in 1956, the Legislature added a section to the law so that lands which would not benefit from being in the district were to be excluded when the district was formed,[336] and amended the law to make all other lands in the district liable for taxes regardless of use of water.[337] It is as yet too early to determine the effectiveness of this action.

It might be noted that the provision of the law providing for a charge for the use of water is in direct conflict with R.S. 9:1101 (See *Ownership of Waters,* supra) which provides that: "There shall never be any charge assessed against any person for the use of the waters of the state for municipal, industrial, agricultural, or domestic purposes." As the irrigation district statutes are the later expression of the legislative will, apparently this sentence of R.S. 9:1101 has been nullified at least so far as irrigation districts are concerned. Nevertheless, it would seem that an irrigation district might still be required to pay for any nonnavigable waters it might take, to the extent that other riparian rights are infringed, under the theory that the right to use these waters is vested in the riparian owners. (See *General Nature of Riparian Rights,* supra.)

Since the 1956 amendment of the law on irrigation districts, the First Joe's Bayou Irrigation District has been formed. A dam and reservoir have been constructed within the District (on Joe's Bayou in East Carroll Parish) by the Department of Public Works, for irrigation, flood control, and other purposes.[338] Water and flowage rights were

---

[333] L.S.A.—R.S. 38:2116.

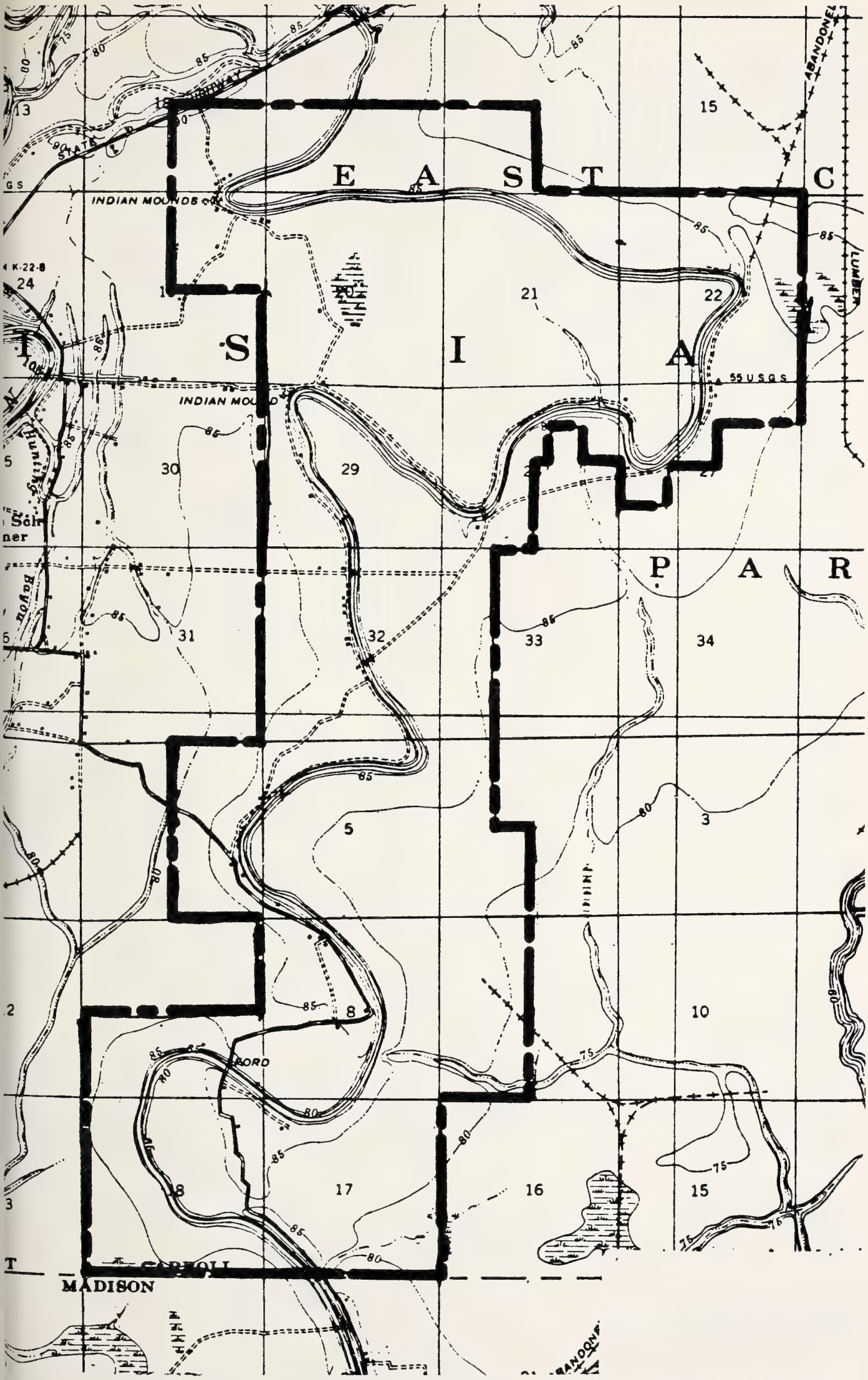
[334] L.S.A.—R.S. 38:2118.

[335] See *Water Problems in the Southeastern States,* Louisiana Legislative Council, Research Study No. 11 (Dec., 1957), pp. 28-29.

[336] L.S.A.—R.S. 38:2101 (C), added by Acts 1956, No. 462.

[337] L.S.A.—R.S. 38:2118, as amended by Acts 1956, No. 461.

[338] The Department utilized some of its general operating funds for this purpose. The legislation on irrigation districts provides that an irrigation district may coordinate its works with state and federal flood control works and navigation projects. L.S.A.—R.S. 38:2112.



First Joe's Bayou Irrigation District (8750 acres, East Carroll Parish, Louisiana. Heavy, black line indicates district boundary.)

acquired by the district from adjoining landowners in consideration c expected benefits resulting from the impoundment of water for irrig: tion, stock, and recreational purposes. Some irrigation water was take from the structure in 1958 by one adjoining owner. As of April 1959, no assessments or charges or water use regulations had been in posed and no attempt had been made by the district to sell any revenu bonds.[339]

Waterworks Districts

Police juries may divide their respective parishes into waterworl districts. Each district is authorized to construct, operate, and maintai a "waterworks system." It may exercise the power of expropriation an may issue bonds and levy taxes for such purposes. It may dispense wat to persons within or outside the district. Twenty-five or more landowne within a proposed district may by petition require the police jury t establish such a district.[340]

It also may be noted that the *Bayou Lafourche Fresh Water Distri* was authorized by constitutional amendment in 1950 "for the purpose c furnishing fresh water from the Mississippi River to the incorporate villages, towns and cities within its boundaries or adjacent thereto . . ."[3 Legislation has been enacted to create such a district and to authori expenditure of state funds in furtherance thereof.[342]

Soil Conservation Districts

The interrelationship between soil conservation and water contr is so great that many measures taken in the field of soil conservatio must of necessity entail a certain control over water also. For exampl one important method of conserving the soil is to retard the spee with which water runs off it and thereby to reduce the amount of so that is carried away. Furthermore, the enabling legislation which pr vides for the creation of Soil Conservation Districts, as amended i 1956, specifically authorizes such districts to perform broad functio with respect to water resources, in addition to carrying out various so conservation measures.[343] We shall discuss this legislation primari in terms of its relation to water resources. It is clear that the legisl tion is concerned with more than soil practices, for included in tl legislative declaration of policy is the statement that the policy the Legislature is to provide "for the prevention of floodwater ar sediment damages, and for furthering the conservation, development, utilization, and disposal of water."[344]

---

[339] Based on information supplied by Henry McPherson, President of the D trict, Frank Byerley, Secretary-Treasurer of the East Carroll Parish Police Jury, a Calvin T. Watts, Assistant Director, Louisiana Department of Public Works.

[340] L.S.A.—R.S. 33:3811, et. seq. Seventeen waterworks districts were reported be in existence in the 1957 U. S. Census of Governments, Vol. 1, No. 3, Local Go ernment Structure, p. 36.

[341] L.S.A.—Const. of 1921, Art. 15, sec. 3.

[342] Acts 1950, No. 113; Acts 1952, No. 192; see also Acts 1952, Nos. 191 and 566.

[343] La. Acts 1938, No. 370, amended by La. Acts 1956, No. 10, and also by A 1958, No. 231. Acts are embodied in L.S.A.—R.S. 3:1201—3:1217.

Twenty-six soil conservation districts, collectively covering the entire state (except Plaquemines Parish) were in existence in January, 1959.[345] The legislation specifies that each district shall be governed by five supervisors, of whom two are appointed by the State Soil Conservation Committee and three are elected by the landowners of the district.[346]

The districts have the power "To carry out preventive and control measures and works of improvement for flood prevention or the conservation, development, utilization and disposal of water within the district . . . on lands owned or controlled by this state or any of its agencies, with the cooperation of the agency administering and having jurisdiction thereof, and on any other lands within the district upon obtaining the consent of the owner as well as occupants of such lands or the necessary rights or interests in such lands."[347]

The districts are authorized "to acquire, by purchase, exchange, lease, gift, grant, bequest, devise, or otherwise, any property . . . or rights or interests therein . . ."[348] In this connection, it is also provided that "No provision with respect to the acquisition, operation, or disposition of property by other public bodies shall be applicable to a district organized hereunder unless the legislature shall specifically so state."[349] It is expressly stated that the districts may not levy taxes or special assessments.[350]

One purpose of the districts is to cooperate, assist, and enter into agreements with individual landowners in the carrying out of works of improvement for the conservation, development, and utilization of water. (A district may use funds received from state or federal agencies or income from its property.) This would be voluntary on the part of the landowner, although the supervisors could attach such conditions to the aid as they deem necessary.[351]

It would appear that such districts do not have broad powers to make regulations to control water use. There is, however, a method by which the supervisors could promulgate regulations having the force of law. The supervisors of each district are authorized to formulate regulations, including provisions to require the carrying out of necessary engineering operations such as construction of terraces, terrace outlets check dams, dikes, ponds, ditches, and other necessary structures.[352] These formulated regulations must then be presented to the landowners of the district in a special referendum. If approved by a two-thirds majority of the votes cast, the regulations may be enacted into law by the supervisors.[353] Administrative and judicial processes are available to any landowner who feels that the ordinance imposes great practical difficulties or unnecessary hardship upon him.[354]

---

[344] The act commences with a legislative determination that to "prevent floodwater and sediment damages, and further the conservation, development, utilization, and disposal of water, it is necessary that . . . works of improvement for flood prevention or the conservation, development, utilization, and disposal of water be adopted and carried out; . . ." L.S.A.—R.S. 3:1201 (D).

[345] See L.S.A.—R.S. 3:1204 (A) in which the names of the 26 districts are listed.

[346] L.S.A.—R.S. 3:1205 (F), R.S. 3:1206, and R.S. 3:1207.

[347] L.S.A.—R.S. 3:1208 (1).

[348] L.S.A.—R.S. 3:1208 (3).

[349] L.S.A.—R.S. 3:1208 (10). For an opinion that such districts apparently do not have expropriation powers, see Opinion, dated Jan. 10, 1955 of Mr. Carrol Buck, 2nd Ass't Attorney General, State of Louisiana.

[350] L.S.A.—R.S. 3:1208 (11).

[351] L.S.A.—R.S. 3:1208 (2), (7), (9).

The *State Soil Conservation Committee* acts primarily as a coordinating and advisory agency for the soil conservation districts and assists in obtaining the cooperation of the Soil Conservation Service, U. S Department of Agriculture, and other federal or state agencies in the operation of such districts.[355]

Sabine River Authority

In 1950, the Legislature provided that:

> All the territory in the parishes of DeSoto, Sabine, Vernon, Beauregard, Calcasieu and Cameron, lying within the watershed of the Sabine River and its tributary streams, shall be embraced in the limits of and shall constitute a conservation and reclamation district to be known and styled 'Sabine River Authority, State of Louisiana.'[356]

The Authority is governed by a 12-member board of commissioners.[357] It is an agency and instrumentality of the state and is corporation and body politic, invested with all rights and immunities conferred by law upon other corporations of like character within th state. Expressly withheld from the Authority, however, is the power to levy taxes. However, it is not required to pay property taxes, nor excise, license, or other taxes on its operating revenues. All bonds issued and their transfer and income therefrom are likewise exempted from taxation within the state.[358]

---

[352] L.S.A.–R.S. 3:1209.

[353] L.S.A.–R.S. 3:1209.

[354] L.S.A.–R.S. 3:1212.

[355] L.S.A.–R.S. 3:1204 (D). The Committee consists of seven members. Five ar elected by the soil conservation district supervisors in convention (one member from each of five state areas). The other two are the Dean of the College of Agriculture o the Louisiana State University and the State Commissioner of Agriculture. L.S.A.–R. 3:1204 (A).

[356] L.S.A.–R.S. 38:2321. The provisions covering the Authority are contained in L.S.A.–R.S. 38:2321 through L.S.A.–R.S. 38:2337. The original provisions concernin the Authority were set forth in Act No. 261 of 1950 and also Act. No. 260 of 1950 The two Acts were identical in terms and purpose, but Act. No. 260 contained a additional section conditioning the operative force of the Act to the ratification o an amendment to Article XIV of the Louisiana Constitution. When this amendmen failed of passage, Act. No. 260 was ineffective. Act No. 261, not being dependen upon the Constitutional amendment, remained in effect, forming the basis of th present Statutes. Certain amendments to the Act were enacted in 1956. (Acts 195 Nos. 116 and 432.) A proposed constitutional amendment to incorporate the legislation creating the Authority in the State Constitution (Acts 1956, No. 632) was vote against by the people.

[357] L.S.A.–R.S. 38:2322. The Director of Public Works is a member and chairma of the board, ex officio, while the other 11 members are appointed by the Govern for terms of four years. Four of the members appointed by the Governor must b residents of Sabine Parish, two of Vernon Parish, and two of DeSoto Parish.

The powers of the Authority are comprehensive. It has the power:

> To conserve, store, control, preserve, utilize, and distribute the waters of the rivers and streams of the Sabine watershed; to drain and reclaim, or cause to be drained and reclaimed, the undrained or partially drained marsh, swamp and overflow lands in the district of said Authority, with the view of controlling floods and causing settlement and cultivation of such lands; and in addition to all of the aforementioned powers for the conservation and beneficial utilization of water resources, to control and employ such waters of the Sabine River and its tributaries in the State of Louisiana, including the storm and flood waters thereof, as are hereinafter set forth;[359]

The particular "control and employment" of the waters set forth following the above-quoted paragraph includes distribution and conservation of the water for domestic, municipal, irrigation, hydroelectric, manufacturing, flood control, and navigation purposes.[360]

The applicable legislation also provides:

> So far as authority is vested in the legislature to grant such right, the Sabine River Authority is hereby expressly granted and vested with full right to use all waters and to possess all water rights in the waters of the Sabine River and its tributaries necessary to the carrying out of its corporate objectives, and the right herein so vested in the Authority shall be prior and superior to all other rights in such waters, provided only that water and riparian rights now vested in private persons or entities shall not be taken or damaged without the paying of adequate compensation therefor, which compensation shall be determined in the manner hereinafter provided for the expropriation of property.[361]

The Authority is expressly granted the power of expropriation.[362]

For the purpose of providing funds for the acquisition of any property, including the acquisition of water rights, the Authority may issue bonds in anticipation of the collection of its revenues. Total indebtedness cannot exceed $50,000,000. The Authority may pledge to the payment of all such bonds all or any part of its revenues, and, additionally, may secure them by mortgage lien or deed of trust upon all or any properties it may own.[363]

---

[358] L.S.A.–R.S. 38:2324.

[359] L.S.A.–R.S. 38:2325 (J).

[360] L.S.A.–R.S. 38:2325 (J).

[361] L.S.A.–R.S. 38:2328 (E). It may be noted here that there possibly are no private vested rights in the waters of navigable streams. See *Navigable Watercourses: Right to Use Water,* supra.

[362] L.S.A.–R.S. 38:2325 (b).

[363] L.S.A.–R.S. 38:2330.

The Authority has no powers of taxation, but it may obtain revenues under its power to collect charges and rentals for its facilities and services.[364] This power to charge for facilities and services might conflict with the provision of L.S.A.–R.S. 9:1101 which provides that: "There shall never be any charge assessed against any person for the use of the waters of the state for municipal, industrial, agricultural, or domestic purposes." Whatever conflict that might be involved, however, has been resolved by Section 8 of Acts 1956, No. 432, which reads, in part, "To the extent that there may be any conflict between the provisions of R.S. 9:1101 and the provisions of this Act, the provisions of this Act shall be controlling."[365]

Further powers of the Authority authorize it to establish or provide for public parks and other recreation facilities and to acquire land for such purposes, to make contracts to effect the construction and operation of toll bridges or ferries over water owned by it, and to own and operate toll bridges and ferries across any of the waters within its jurisdiction.[366] The board of commissioners also has the power to adopt and promulgate all reasonable regulations relating to sanitary conditions of all waters in its reservoirs and all waters flowing into its reservoirs. They can also regulate residence, hunting, fishing, boating and camping and all recreational and business privileges in and around its reservoirs, the Sabine River and its tributaries.[367]

The only express power regarding pollution that is given the Authority is that which authorizes the board of commissioners to make regulations to preserve the sanitary conditions of its reservoirs.[368] Its general powers over rivers and streams include those to "conserve, store, control, preserve, utilize and distribute" and "to control and employ."[369] It is difficult to determine to what extent these words grant general powers to control pollution. It may be noted that the Stream Control Commission has been given broad powers of control over pollution of the waters of the state.[370] In view of the broad powers over pollution given the Commission and the lack of any specific grant of such powers to the Authority, the Stream Control Commission perhaps has jurisdiction, either exclusively or concurrently, over pollution within the Authority's territorial limits.

In brief, the Authority is given the power to control and distribute the waters of the rivers and streams within its jurisdiction in the way it deems to be most beneficial, taking into account all uses that might be made of the water by competing interests. It must, however, provide adequate compensation for any vested riparian or other water rights which are taken or infringed in the course of this control and distribution, as noted earlier. The Authority's control is subject also to the provisions of the Sabine River Compact, discussed later.

---

[364] L.S.A.–R.S. 38:2325 (f).

[365] In this Act, an amending act to the original Sabine River Authority act, the Authority is granted the right to make charges for the facilities and services of the Authority.

[366] L.S.A.–R.S. 38:2333, R.S. 38:2332, and R.S. 38:2335, respectively.

[367] L.S.A.–R.S. 38:2331.

[368] Ibid.

[369] L.S.A.–R.S. 38:2325 (J).

[370] See *State Stream Control Commission,* supra.

The only permit issued by the Authority as of January 1, 1959, was to the city of Logansport to take water from the Sabine River for municipal use. Pending before the Authority was an application by the Anacoco-Prairie State Game and Fish Commission to impound water on Upper Bayou Anacoco in Vernon Parish. (This project is discussed under *Fish and Game Preserves.*)

The Authority also has made a study determining the feasibility of, and is planning the construction of, a multiple-purpose dam and reservoir on the Sabine River at Toledo Bend. The dam and reservoir would provide hydroelectric power and water supplies for irrigation, municipal, and industrial purposes. The Authority is cooperating in this endeavor with the Sabine River Authority of Texas. It may be noted that, in carrying out its responsibilities, the Authority is authorized to cooperate with local agencies and private persons and with any agency of the state of Texas or the United States. It may contract with them for the joint construction, operation, or ownership of needed facilities.[371]

Bayou D'Arbonne Lake Watershed District

In 1956, the Legislature created the Bayou D'Arbonne Lake Watershed District, embracing the area of the watersheds of Bayou D'Arbonne, Bayou Corney, Bayou Little D'Arbonne, and Bayou Middle Fork in Lincoln and Union parishes.[372] It is a political subdivision of the state, having as its purpose the conservation of soil and water and the development of the natural resources of the district for sanitary, recreational, and agricultural purposes.[373] It constitutes a body corporate in law, with all powers of a political subdivision of the state relating to the incurring of debt and the issuing of bonds therefor. It has the power of expropriation and may use such power to expropriate property for all its purposes and objectives.[374]

It is empowered to conserve the fresh water supply within its boundaries for the benefit of the inhabitants and property owners within the district and the state, to provide water for commercial, municipal, and any other uses, both within and without the district. It may own in full ownership all servitudes, rights of way, and flowage rights and may acquire same by donation, prescription, purchase, expropriation, or otherwise.[375]

However, "any individual from whom flowage rights, rights of way and servitudes may have been acquired by any means" shall retain his mineral rights in the lands so encumbered, and lands covered b the lake shall be exempt from all state and local taxes.[376]

---

[371] L.S.A.–R.S. 38:2329.

[372] L.S.A.–R.S. 38:2551.

[373] L.S.A.–R.S. 38:2552.

[374] L.S.A.–R.S. 38:2553.

[375] Ibid.

The district is governed and controlled by a Board of Commissioners which consists of five members who are appointed by the Governor fo terms of four years each.[377] The board acts for the district in the exercise of the powers set forth above, but it is subject to certain restrictions It is to assist in conserving soil and water and in developing the wate resources of the district; however, it is to do nothing to interfere witl districts previously organized under Louisiana law.[378] Further, all th powers conferred upon the board are subject to the supervisory contro of the Department of Public Works and the Wildlife and Fisherie Commission, with jurisdiction by the latter over the fish, game, an wildlife of the watershed.[379]

The Board of Commissioners is empowered to make necessary an advisable rules and regulations:

(1) To protect and preserve the properties owned by the distric prescribe the manner of their use by public corporations an persons, and preserve order within and adjacent thereto;

(2) To prescribe the manner of building bridges, roads, fences c other works in, along or across any channel, reservoir or othe construction of the district;

(3) To prescribe the manner in which ditches, sewers, pipelines, c other works shall be adjusted to or connected with the worl of the district or any watercourse therein, and the manner i which the watercourses of the district may be used for sewe outlets or for disposal of waste;

(4) To prescribe the permissible uses of the water supply provide by Bayou D'Arbonne, a lake to be created within the distric to collect fees therefor, to determine the manner of its distrib tion, and to prevent the pollution or unnecessary waste of suc water supply;

(5) To prohibit or regulate the discharge into sewers of the di trict of any waste deemed detrimental to the works or improv ments of the district;

(6) To coordinate and cooperate with the Department of Publ Works in the construction by the Department of a dam and ir poundment of Bayou D'Arbonne;

(7) To regulate hunting, fishing, boating, and any and all activiti upon the waters of the lake created by the impoundment.[380]

---

[376] L.S.A.–R.S. 38:2570 to 38:2572. (See Acts 1956, No. 351 for a similar prov sion regarding lands used for a game and fish preserve.) These sections also gra to the district the right to use any state-owned lands within the district for tl purpose of constructing the Bayou D'Arbonne Lake and related structures.

[377] L.S.A.–R.S. 38:2555.

[378] L.S.A.–R.S. 38:2558 (3)

[379] L.S.A.–R.S. 38:2564.

[380] L.S.A.–R.S. 38:2559.

The Department of Public Works is a general supervisory agency over the Board of Commissioners. It is to construct and create the Bayou D'Arbonne Lake, and to this end, it is given full powers of expropriation of property.[381]

The Legislature has appropriated a million dollars to be expended by the Department of Public Works for the purpose of acquiring "the rights of way, flowage rights, and servitudes" and for construction of a dam, reservoir, and other suitable structures for the creation of the lake.[382]

The Wildlife and Fisheries Commission has the right to determine and fix the necessary rules and regulations pertaining to the fluctuation of the waters of the lake and to do any other thing necessary and proper within its discretion for the proper management of fish, game, and wildlife over, along, and upon the lake, working in conjunction with the Board of Commissioners.

Three bodies or agencies exercise jurisdiction over the operations of the watershed district—the district's Board of Commissioners, the Department of Public Works, and the Wildlife and Fisheries Commission. The Department of Public Works apparently is to be in direct charge of the construction of any works necessary to create the Bayou D'Arbonne Lake. The Board of Commissioners of the district is to be in charge of the actual operation and functioning of the district, under the supervision of the Department of Public Works. The Board's general nature would appear to be analoguous to that of a manager with broad general powers. The Wildlife and Fisheries Commission is to retain jurisdiction over the wildlife of the district.

Iatt Lake Water Conservation District

This district was created by a constitutional amendment approved by the people of the state in 1956[383] for the stated purpose of making available "an adequate fresh water supply for industrial and other consumption in the Grant Parish-Rapides Parish area . . ." The district's authorized purposes, among other things, include the furnishing of water to "cities, towns, villages, industries, corporations, and persons both within and outside the District." It may store, control, distribute, and prevent pollution and blocking of, the waters contained in bodies of water in the district. It may construct new dams, channels and levees, and drain the lands. It may also "prevent the escape of any such waters until employed to the maximum advantage of the public generally i aiding the development of agriculture, commerce and industries, and i insuring a fair and just distribution of all of said waters for all of th people of the area for the purposes shown."

---

[381] L.S.A.—R.S. 38:2563.

[382] La. Acts 1956, No. 226. The proposed reservoir is intended to provide a water supply for domestic, agricultural, municipal, and industrial use, and to provide the area with a game and fish preserve. It has been estimated by Mr. Calvin T. Watts, Assistant Director, Louisiana Department of Public Works, that the total cost of the project may approach $2¾ million.

[383] L.S.A.—Const. of 1921, Art. 15, sec. 4. This provides that it is self-executing without any supplementary action by the Legislature.

The district's Board of Commissioners shall consist of five member two each to be appointed by the Police Jury of each parish and on by the Governor. The Board shall constitute an instrumentality of th state and the powers conferred on it "shall be deemed and held to b essential governmental functions" of the state. The board may expropr ate or otherwise acquire or lease property and issue revenue bonc (within prescribed limitations). It may also make certain charges fc its services. It may *not* levy taxes of any kind. But, property acquire and held by the board, and the income therefrom, or from any bonc it issues, is exempt from state and local taxation.

The board is specifically authorized, among other things, (1) t "effectuate and maintain proper depths of water to accommodate th business of the District," (2) "to transfer water between watersheds i the District," (3) "to control the water level in and discharge rat from" the District's reservoirs and other bodies of water in the Distric (4) "to regulate the recreational and other purposes for which sam may be used," (5) "and to take and dispose of all natural water flowin into or originating within the District for all the purposes of th amendment."

It is expressly provided, however, that (1) "the District shall n have authority to destroy or substantially diminish vested water righ without the making of proper compensation therefor," and (2) th Board shall obtain the approval of the Director of Public Works befo issuing any revenue bonds for the payment of any dam or reservoir th may create or aggravate a drainage problem in any city, town, or v lage within the district, and shall provide necessary drainage faciliti in constructing such dam or reservoir.

It is provided also that "the District may impound, treat, and d tribute to consumers of every nature, all water which may be ma available by reason of its facilities and may make appropriate charg therefor . . . provided only that no charges or fees shall be impos which shall have the effect of materially impairing any water righ presently vested in the owners of property in the District." It may ado appropriate rules and regulations governing the fixing and collection charges and fees "for water and services" and may enter into contrac operative within and without the district, with any consumer of wat or water service governing the sale or purchase of water.

It should be noted that legislation was enacted in 1954 to authori the creation of the *Southwest Louisiana Water Conservation Distri* which would encompass several parishes in Southwestern Louisian However, a proposed constitutional amendment to incorporate th legislation in the Constitution was voted against by the people of t state, and the legislation was later repealed, in 1956.[384] The authorized purposes of the district (which were somewhat similar to those of the Iatt Lake Water Conservation District) included the furnishings of fresh water to farm and other lands, to industries, and to cities, towns, and villages within the district. The regulation of groundwater usage, as well as of surface bodies of water, was specifically authorized—to protect against salt water intrusion and for other purposes. Authority also was granted to levy a property tax, within limitations.

Recreation and Water Conservation Districts

A 1954 statute enables parishes to create recreation districts which may engage in activities to promote recreation and own and operate recreational facilities.[385]

Statutes were enacted in 1958 specifically to create (1) the Cypress-Black Bayou Recreation and Water Conservation District, in Bossier Parish, (2) a recreation and water conservation district in St. Helena Parish, and (3) the Black Lake Bayou Recreation and Water Conservation District of Red River Parish.[386] The stated purposes, powers, duties, and related provisions of these three statutes are substantially the same. Each provides, among other things, that the district created shall be a political subdivision of the state for the purpose of developing the wealth and natural resources of the district by the conservation of soil and water for agricultural, recreational, commercial, industrial, and sanitary purposes.

The district's powers under all of these statutes include the power to levy taxes, issue negotiable bonds,[387] and expropriate "property and servitudes, rights of way and flowage rights . . ." Each may lease, build, operate, and maintain appropriate works or machinery, and shall have "complete control over any supply of fresh water made available by its facilities which shall be administered for the benefit of persons residing or owning property within the district and if it should be for the benefit of the district, it shall have the authority to sell such water for irrigation, municipal and industrial uses both within and outside the district." Each may cooperate or contract with the U.S. government and any state department, agency, or corporation for the construction, operation, and maintenance of its facilities, and participate in projects authorized by federal or state law.

---

[384] La. Acts 1954, No. 161; repealed by Acts 1956, No. 427. For proposed constitutional amendment (Art. 15, sec. 4) see Acts 1954, No. 749 (repealed by Acts 1956, No. 382). See Table 8, Acts 1955 which reflects its failure to be adopted.

Acts 1954, No. 486 also was enacted to authorize the Department of Public Works to construct dams, pumping stations, and other facilities within the district, and to authorize it and the Wildlife and Fisheries Commission to make certain studies. Six hundred thousand dollars in expenditures from state funds were authorized by this Act—conditional, however, on adoption of the Constitutional amendment, which failed to be adopted.

[385] L.S.A.—R.S. 33:4562, as amended by Acts 1958, No. 473.

[386] L.S.A.—R.S. 38:2601 et. seq., R.S. 38:2651 et. seq., and R.S. 38:2701 et. seq., respectively.

[387] However, the legislation creating the Cypress-Black Bayou Recreation and Water Conservation District specifically requires authorization by an election of voters in the district.

Other specified powers of the statutes creating recreation and water-conservation districts include regulating recreational activities (including fishing and boating) and prescribing the way in which pipelines or other works shall be connected with the "facilities of the district or any water course within the district and the manner in which the water courses of the district may be used for the disposal of waste . . ." Each district shall exercise its powers under the supervisory control of the State Department of Public Works, which shall furnish it necessary engineering services. The department may cooperate also in construction of works or facilities considered necessary to the district's purposes by the district and the department.

Fish and Game Preserves

Several state fish and game preserves or wildlife sanctuaries have been created in Louisiana by special statutes.[388] There is also a general statute which enables parishes to establish such preserves.[389] These preserves or sanctuaries are under the supervision of the State Wildlife and Fisheries Commission. In addition, the state commission may set aside state-owned lands or lease privately owned lands for such purposes.[390]

In general, these fish and game preserves are intended for the protection and control of the taking of fish and game. The general statute enabling the creation of preserves by parishes purports to give the 3-member commission of each preserve the authority to "do any and all things necessary for the conservation, protection, and propagation of game and fish in the preserve." This specifically includes authority to "build dykes or dams, dig canals, or excavate lake or stream beds." Expropriation powers are provided.[391]

In 1954, the Legislature authorized the State Department of Public Works to construct a dam and other necessary structures "to create and impound a fresh water supply" within the limits of the Anacoco-Prairie State Game and Fish Preserve, in Vernon Parish. State funds appropriated for this purpose included an appropriation for the department to expend "for the purpose of acquiring such lands, servitudes, rights of way, and flowage rights as may be necessary in connection with the development of the Preserve," primarily for the creation and conservation of the fresh water supply.[392] Although these funds are available the Police Jury of Vernon Parish has issued ad valorem bonds in the amount of $875,000 to help finance the project. It is a joint project of the Department of Public Works, the Vernon Parish Police Jury, and the Anacoco-Prairie State Game and Fish Preserve. Project plans have been developed to impound water on upper Bayou Anacoco, and the department has been acquiring rights of ways, flowage rights, etc.

---

[388] See notes under L.S.A.–R.S. 56:801.

[389] L.S.A.–R.S. 56:721 et. seq.

[390] L.S.A.–R.S. 56:763 et. seq., and Const. of 1921, Art. 6, sec. 1 (A). See L.S.A.–R.S. 56:751 for a list of state swamplands perpetually dedicated as a game preserve. The Legislature also has provided for cooperation with the national program of wildlife restoration projects of the U.S. Commissioner of Wildlife and Fisheries, Department of the Interior. L.S.A.–R.S. 56:701 et. seq.

[391] L.S.A.–R.S. 56:722 to 56:725.

[392] La. Acts 1954, Nos. 400 and 401, and Acts 1956, No. 525.

As recreational lake waters already exist in the Preserve, the supply of fresh water to be developed by the project is intended primarily for industrial and other uses. The special statute that created the Preserve in 1948 specifically authorizes the Preserve's Commission (in addition to providing a game and fish preserve through the construction of necessary facilities and regulation of the taking of game and fish) "to create and impound an industrial water supply, as per survey and estimates made and estabilshed by the Department of Public Works . . ."[393] The Preserve also was specifically granted the power of expropriation and the authority to sell revenue bonds.[394]

Levee and Drainage Districts

The Mississippi and other major rivers flowing through the state of Louisiana have created a continuing need to protect the low-lying flood plains from periodic flooding. This has led to construction of an extensive system of levees to contain the waters.[395]

The state constitution authorizes the Legislature to provide for a state-wide levee system.[396] The Legislature has created a number of levee districts, each with a board of levee commissioners.[397] In addition to constructing and maintaining levees, they "may do all drainage work incidental to or made necessary by the construction of the levee system in this or adjoining states."[398]

---

[393] La. Acts 1948, No. 277, amended by Acts 1956, No. 238. It appears that few, if any, of the other fish and game preserves or wildlife sanctuaries in the state have been expressly authorized to develop industrial, municipal, or irrigation water supplies (nor is the State Wildlife and Fisheries Commission expressly so authorized). However, this statement is based on less than a complete review of the several enabling acts.

For other examples of specific authorizations for the Department of Public Works to construct dams within fish and game preserves, see Acts 1957, No. 38, with respect to dams in the Cocodrie Lake Game and Fish Preserve. The commission in this preserve is authorized to operate gates and other regulatory devices on the dams for "preservation and propagation" of fish and wildlife, subject to a prohibition against reducing the minimum record flow in Bayou Cocodrie or impairing the riparian rights of the downstream landowners. See also, with respect to dams authorized in the Northwest Louisiana Game and Fish Preserve area, Acts 1954, No. 510; Acts 1956, No. 491, amended by Acts 1957, No. 15; and Acts 1957, No. 44.

[394] La. Acts 1948, No. 277, sec. 12.

[395] See *Water Problems in the Southeastern States,* Louisiana Legislative Council Research Study No. 11, Baton Rouge (Dec., 1957), page 38 et. seq.; Asseff, Emmett, *Special Districts in Louisiana,* Bureau of Government Research, Louisiana State University (1951), p. 28 et. seq.; *Louisiana Levee Districts,* Public Affairs Research Council of Louisiana, Baton Rouge (Aug., 1958); and Harrison, Robert W., *Flood Control in the Mississippi Alluvial Valley,* Delta Council, Stoneville, Miss. (undated).

[396] L.S.A.–Const. of 1921, Art. 16.

[397] L.S.A.–R.S. 38:641 et. seq.

The State Constitution provides that such districts may cooperate with the federal government and neighboring states in the construction and maintenance of the levees.[399] Moreover, they (as well as drainage districts) may contract with the State Department of Public Works to have it bear a portion of the cost of reclamation and drainage projects.[400]

Legislation (L.S.A.—R.S. 38:221) prohibits anyone from placing any rice-flume or other type of conduit "in, through or under" any public levee if ordered not to do so by the levee board or governing authority of the parish.[401] Violators may be fined up to $500 and/or imprisoned up to 60 days. This does not apply, however, to those levee on the Mississippi River outside the limits of the Fifth Louisiana Levee District, the Atchafalaya Basin, the Lafourche Basin, the Grand Basin the Buras, and the Orleans Levee Districts.[402] Any permission granted to operate siphons "over" the public levees shall be subject to the following regulations found in R.S. 38:222:

1. The location of all siphons shall be at right angles to the axis of the public levee.
2. The levee shall at no place . . . be cut into nor disturbed . .
3. The . . . ends of all siphons shall be located . . . not less than 30 feet on the river side nor 60 feet on the land side from the base of the levee.
4. Both . . . ends . . . shall be so protected as to guard agains any local excavation or washout.
5. In the operation of siphons for irrigation . . . no area within 150 feet of the base of any public levee on the land side shall . . . be flooded.
6. All areas subject to flooding . . ., shall be provided, by the owner or operators, with low level ditches (for drainage o levees and highways).
7. No siphons shall be placed over the levees designated in R.S 38:221 until permission has been obtained from the board o commissioners of the levee district having jurisdiction over the levees.

---

[398] L.S.A.—R.S. 38:281.

[399] L.S.A.—Const. of 1921, Art. 16, secs. 4 and 5. See also R.S. 38:551 et. se and 38:112. The state, with the concurrence of an adjoining state, may create leve districts composed of territory partly in each state and may authorize the construction of levees wholly in another state. Levee construction and other flood contr functions of the Corps of Engineers, U. S. Army, in which levee districts have co operated in various ways are discussed in *Louisiana Levee Districts,* supra, pp. 9-1 *Special Districts in Louisiana,* supra. pp. 32-34; *Water Problems in the Southeaste States,* supra, p. 40.

[400] L.S.A.—R.S. 38:111.

[401] The consent of the State Department of Public Works, as well as the governin bodies of any cities or municipalities in which the public levees may be located, ma be required also.

[402] Nor does it apply to locks that connect navigation canals with the Mississip River. Special provisions apply to the conduits for sewerage, gas, or electricity municipalities and parishes.

R.S. 38:223 extends section 5 of R.S. 38:222 by stating that:

> No person shall in any manner cover with water for any purpose, on the land side of any public levee or levees, any land situated upon the Mississippi River within a distance of 150 feet from the base of any public levee.

Attaining satisfactory land drainage also has been a major problem in Louisiana (and often has been aggravated by the levees built for flood protection).[403] The State Constitution authorizes the Legislature to provide for the creation of drainage and subdrainage districts.[404] Under this authority, legislation has been enacted that enables the creation of two general types of drainage districts: (1) Gravity drainage districts and subdistricts[405] and (2) drainage districts and subdistricts requiring leveeing and pumping.[406] Several such districts have been created.[407] Such districts may be created by the police juries of the respective parishes. If they fail to do so in areas needing a drainage district, they may be required to create a district when petitioned to do so by a certain proportion or number of property owners owning land in the proposed district. But the approval of the Department of Public Works is required before any drainage district requiring leveeing and pumping may be created.[408]

A statewide drainage program is being encouraged and assisted by he Department of Public Works to effect better coordination of the drainage systems throughout entire parishes and watersheds, as the projects of some districts have aggravated drainage and flooding problems in others.[409]

Police juries may construct and maintain drainage ditches and canals nd perform related functions.[410] Legislation enables parishes to assume debts of drainage districts if approved by a referendum,[411] and also nables the formation of consolidated drainage districts.[412] In addition, the Legislature itself has directly created some consolidated gravit drainage districts,[413] as well as certain "levee and drainage districts," including (1) the Cane River, (2) the Lafourche Basin, and (3) th Red River-Bayou Pierre, levee and drainage districts.[414]

---

[403] See Harrison, Robert W., "Louisiana's State Sponsored Drainage Program," *The Southern Economic Journal,* Vol. XIV, No. 4 (April 1948), p. 388.

[404] L.S.A.–Const. of 1921, Art. 15, secs. 1 and 2. This also authorizes cooperation with the federal government in drainage and reclamation projects. See also R.S. 8:81.

[405] L.S.A.–R.S. 38:1751 et. seq.

[406] L.S.A.–R.S. 38:1601 et. seq.

[407] See *Water Problems in the Southeastern States,* Louisiana Legislative Council Research Study No. 11 (Dec., 1957), which includes a discussion of drainage districts, on pp. 33-38. (Levee districts are also discussed, on pp. 38-41.)

[408] L.S.A.–R.S. 38:1605 and 38:1703.

[409] See pp. 33-34 of *Water Problems in the Southeastern States,* Louisiana Legislative Council Research Report No. 5, Baton Rouge, April 7, 1955. The report stated hat 25 parish-wide drainage systems had been adopted. See also pp. 37-38 of Dec., 957 revision (Research Study No. 11); Harrison, Robert W., "Louisiana State Sponsored Drainage Program," supra, note 403; Asseff, Emmett, *Special Districts in Louisiana,* supra, note 395.

[410] See *Police Juries,* supra.

[411] L.S.A.–R.S. 39:661 et. seq.; Const. of 1921, Art. 14, sec. 14, as amended by cts 1946, No. 386. This also applies to levee and irrigation districts and certain ther types of districts.

[412] L.S.A.–R.S. 38:1660 and R.S. 38:1841 et. seq.

As is the case with levee districts, there are several detailed provision regarding the creation, dissolution, operation, and financing of thes types of districts which we shall not discuss.[415] Such districts have va rious powers to issue bonds, levy taxes, and expropriate property, withi limitations, for a variety of purposes.

Enabling legislation provides that drainage districts requiring levee ing and pumping may be formed "for the purpose of drainage an reclaiming the undrained or partially drained marsh, swamp, and over flowed lands in Louisiana that must be leveed and pumped in order t be drained and reclaimed . . ."[416] It is specifically provided that an such drainage district "may open, deepen and enlarge natural drain within or without the district . . . to make the natural drains e fective."[417] ". . . All watercourses shall, if necessary to the drainage o any of the lands in the district, be connected with and made a par of its drainage system."[418] It may also straighten or change the cours and flow of any watercourse, pond, lake, creek, bayou or natural stream fill up any natural stream, and concentrate, divert, or divide the flo of water, provided it makes "adequate provision for the drainage of al lands and property affected thereby." It may construct and maintai ditches, canals, levees, dams, reservoirs, holding basins, and other work of improvement. It may employ expropriation powers for a variety o purposes, including the acquisition of lands, servitudes, reservoirs, hold ing basins, and rights of way for levees, canals, and ditches.[419]

Gravity drainage districts are provided with more or less simila powers for establishing gravity drainage systems.[420] Their commissione are specifically authorized to perform all acts "necessary to fully drai all the land in their districts and maintain the drainage when estab lished."[421] This includes authority "to adopt all needful regulations ne essary to maintain free and unobstructed the flow of water through th gravity canals, ditches, and drains." The commissioners may also re quire and control the operation of floodgates in fences that cross th drains, ditches, and canals.[422]

Any drainage district may make provision for the navigation o anals established in its system of drainage.[423] No specific reference to rrigation has been discovered in the enabling legislation. In this connection, the authors are informed that a few years ago some rice armers, who were pumping water out of the parishwide drainage-system anals controlled by the East Carroll Police Jury, were requested to top using the canals for irrigation. At their request, the farmers were permitted to complete that season's irrigation. Later, they drilled irrigaion wells, as requested, and stopped using the canals.[424]

---

[413] La. Acts 1956, No. 234; Acts 1946, No. 91.

[414] L.S.A.—R.S. 38:1951 et. seq.

[415] L.S.A.—R.S. 38:1481 et. seq.

[416] L.S.A.—38:1602.

[417] L.S.A.—R.S. 38:1614.

[418] L.S.A.—R.S. 38:1638.

[419] See L.S.A.—R.S. 38:1614 and 38:1638-1640.

[420] L.S.A.—R.S. 38:1764 and 38:1767.

[421] L.S.A.—R.S. 38:1767. See also R.S. 38:1794.

[422] L.S.A.—R.S. 38:1794.

General legislation provides that the various levee and drainage disricts shall have control over all "public drainage channels" within their imits that are adopted, with or without improvement, as parts of their rainage system, with the approval of the Department of Public Works. They may adopt rules and regulations for preserving the efficiency of uch drainage channels.[425]

Federal Watershed Protection And Flood Prevention Act

In 1954, the Congress of the United States enacted the Watershed rotection and Flood Prevention Act. As later amended, this act, in eneral, provides for Federal technical, financial and other assistance o such local agencies and organizations as are authorized under state aw to assume responsibility for initiating, carrying out, maintaining, nd operating works of improvement to help conserve, develop, utilize, nd dispose of water for a variety of purposes, including the prevention f erosion and flood water and sediment damages, and the supplementng of any needed downstream flood control measures.[426] Any state or olitical subdivision thereof, soil or water conservation district, flood revention or control district, or other local public agency having auhority under state law to carry out, maintain, and operate the works f improvement is eligible to participate in the program.

ype of Assistance

Upon request, the Department of Agriculture is authorized, among ther things, to assist local organizations under specified conditions in: a) conducting surveys and investigations and preparing plans of work, b) making allocations of costs to the various purposes and determining hether benefits exceed costs, (c) entering into agreements to furnish nancial and credit assistance, within specified limitations, and (d) obining the collaboration of other federal agencies. The Soil Conservaon Service has been assigned the responsibility of providing such asstance, except that the Farmers Home Administration has been assigned the responsibility of making loans and advancements. For certai projects, the approval of certain congressional committees and/or th recommendations of the Departments of the Interior and/or Arm shall be obtained.

---

[423] L.S.A.—R.S. 38:1482.

[424] Based on information supplied by Mr. Frank Byerley, Secretary-Treasurer, olice Jury of East Carroll Parish. See note 411, supra, regarding parishwide draine systems.

[425] L.S.A.—R.S. 38:113.

[426] 68 Stat. 666, 70 Stat. 1088, 72 Stat. 563, 567, and 1605; 16 U.S.C.A. sec. 1001 seq. See also Executive Order No. 10584 (Dec. 20, 1954).

Conditions of Assistance

To be eligible for assistance from the Federal government, th local organization must (a) agree to acquire without cost to the Fe eral government the necessary land, easements, and rights of wa (b) acquire, or provide assurance that landowners or water users hav acquired such water rights, pursuant to the state law, as may be neede in the installation and operation of the works of improvement, (c) o tain agreements to carry out recommended soil conservation measur and proper farm plans from owners of not less than 50 percent of th land situated in the general area above each retention reservoir to l installed with Federal assistance, (d) agree to assume a proportiona share of the cost of installing any works of improvement applicable the agricultural phases of the conservation, development, utilizatio and disposal of water, or for fish and wildlife development, and a of the costs applicable to other purposes, such as capacity for industri and municipal water supplies, except that any part of the constructic cost (including engineering costs) applicable to flood prevention an related features shall be borne by the Federal government, (e) agr to make satisfactory arrangements for defraying the cost of operati and maintaining such works, and (f) construct or let contracts f improvements on privately owned property.

Limitations on Size of Projects and Structures

No project under this legislation shall embrace a watershed or su watershed area in excess of 250,000 acres nor shall any single structu have a floodwater detention capacity of more than 5,000 acre-feet nor total capacity of more than 25,000 acre-feet.

The authors are informed that by March 1, 1959, the U. S. Depa ment of Agriculture had received 22 applications for approval of su watershed projects in Louisiana. Nine such applications had been a proved by the Department for preparation of a work plan. Four these had been approved for operation and, in one, construction wo was underway. The sponsoring local organization in all of these proje has been a soil conservation district. A town council was co-sponsor one project. It may be noted that the enabling legislation regarding s conservation districts, as amended in 1956, has broadened the a thorized purposes of such districts so as expressly to include the preve tion of floodwater and sediment damages and the furtherance of t conservation, development, utilization, and disposal of water.[427]

---

[427] See *Soil Conservation Districts,* supra, for a more detailed discussion of th functions. The Attorney General has stated that soil conservation districts may as "local organizations" under this federal legislation. See opinion dated January 1955, of Mr. Carrol Buck, 2nd Assistant Attorney General, State of Louisiana.

The project under construction is in the Bayou Dupont Watershed in Natchitoches and Sabine parishes. The project embraces 56,610 acres. Its primary purpose is the prevention of floodwater and sediment damages. In this connection, soil and water conservation practices will be carried out voluntarily on individual farms, and the Upper West Red River Soil Conservation District (which is the sponsoring organization) has awarded contracts to private contractors for the construction of 8 of 22 contemplated floodwater-retarding structures (dams and reservoirs) within the watershed.[428]

The other projects that had been approved for operation are the Upper Bayou Nezpique Watershed project (embracing an area of 214,000 acres), the Upper West Fork of Cypress Bayou Watershed project (5,500 acres) and the Bear Creek Watershed (13,500 acres). A primary purpose of each project is the same as the Bayou Dupont project—the prevention of floodwater and sediment damage. However, the Upper West Fork project also includes provisions for supplying Plain Dealing with city water when the need arises, and water for fish and wildlife development, while the Bear Creek project includes provisions for the drainage of wet lands.

The five additional projects that had been approved for planning and their stated purposes are (1) the Johnson Bayou (drainage and flood prevention), (2) the Bayou Rapides (irrigation), (3) the Big Ditch, Pleasant Valley, and Scarborough Creek (prevention of floodwater and sediment damage), (4) the Beaver Button, Bentley Hollow, and Cook Creek (prevention of floodwater and sediment damage) watershed projects, and (5) Baker Canal (flood prevention and drainage).[429]

Interstate Compacts

Sabine River Compact and Administration

In 1953, Louisiana and Texas entered into a compact regarding the distribution and use of the waters of the Sabine River watershed.[430]

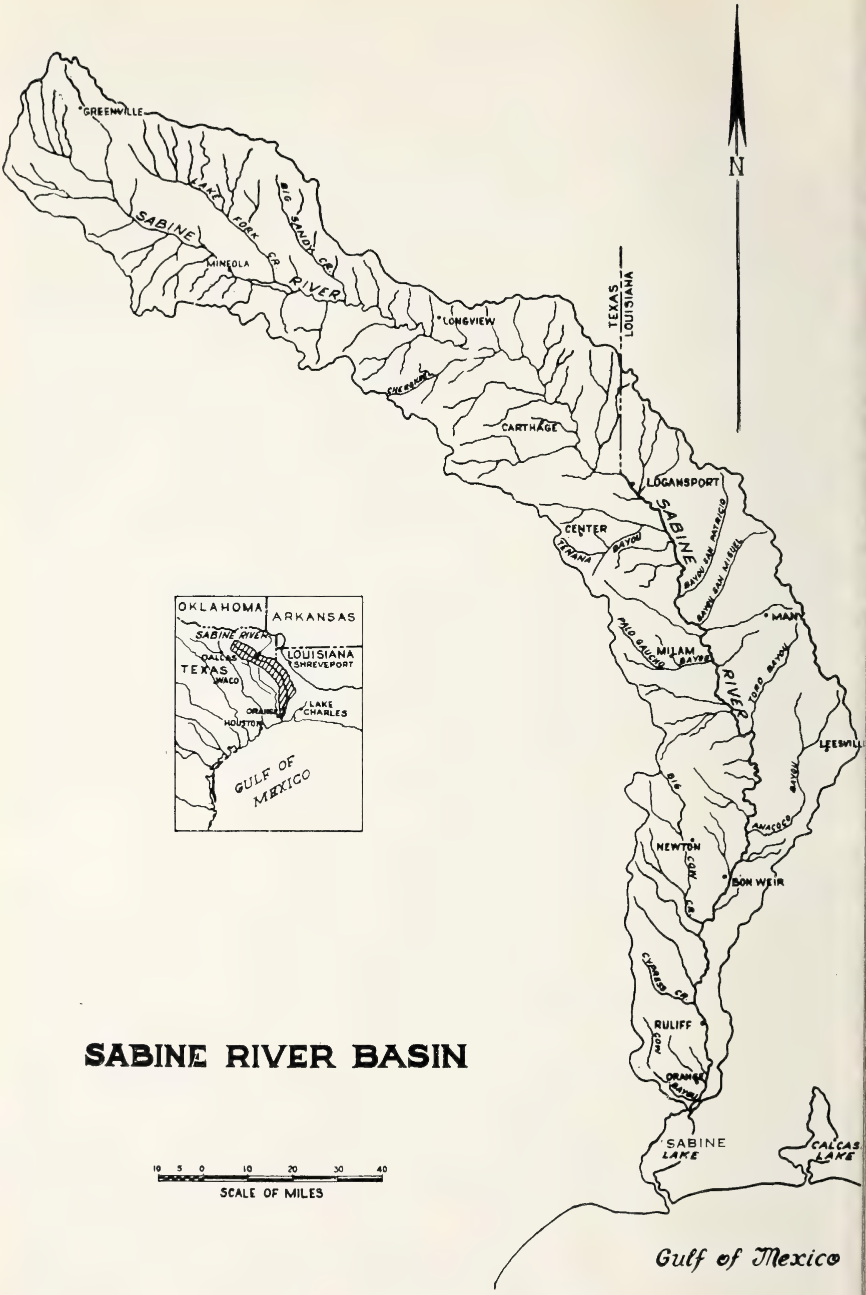
The compact deals only with distribution and use of the waters, it being set forth at the outset that:

---

[428] It may be noted that in 1956, the Legislature appropriated funds for the Department of Public Works to expend in construction of dams, reservoirs, and related structures so as to regulate the flow of Bayou Dupont (La. Acts 1956, No. 421). But a 1957 amendment limited the department's authority to expend these funds to the purposes of "making water resources studies and in developing irrigation and water conservation projects" acting alone or in cooperation with other agencies or districts. (La. Acts 1957, No. 14.)

[429] The above description of watershed projects is based on information supplied by Mr. H. B. Martin, State Conservationist, Soil Conservation Service, U.S.D.A., Alexandria, La. A publication entitled "Facts About the Watershed Protection and Flood Prevention Act" may be obtained from his office.

[430] The compact was signed January 26, 1953. It was ratified, approved, and confirmed by the Louisiana Legislature by Acts 1954, No. 36, L.S.A.—R.S. 38:2329 et. seq.; by the Texas Legislature, by Acts 1953, ch. 63, Vernons Ann. Tex. Civ. St. art. 7466 i; and by Congress by the Act of Aug. 10, 1954, c.668, 68 stat. 690.



SABINE RIVER BASIN

The Sabine River Compact provides for the equitable apportionment of the wate of the Sabine River between the states of Louisiana and Texas. As used in th Compact, "Stateline reach" extends from "Stateline," which is a point just north Logansport, La., to Sabine Lake.

> It is recognized that pollution abatement and salt water intrusion are problems which are of concern to the States of Louisiana and Texas, but inasmuch as this Compact is limited to the equitable apportionment of the waters of the Sabine River and its tributaries between the States of Louisiana and Texas, this Compact does not undertake the solution of those problems.[431]

The compact is intended to settle any present or future controversy between the states concerning the use of the waters of the Sabine River where it forms the border of Texas and Louisiana. The point at which the waters in downstream flow first touch both states is defined to be the "Stateline."[432] (See page 106.) Above the Stateline, Texas has free and unrestricted use of all waters of the river and its tributaries, subject to certain provisions.[433] One of these provisions is that nothing in the compact shall be construed as affecting any present or future rights or powers of the United States in, to, and over the waters of the Sabine River Basin.[434] The other provision is that neither state may reduce the flow of the river so that its flow at the Stateline falls to less than 36 cubic feet per second.[435] Reservoirs and permits above the Stateline existing as of January 1, 1953, are not liable for maintenance of this flow, but those reservoirs on which construction was commenced after this date are liable for maintaining such flow. It should be noted that minimum flows of less than 36 cubic feet per second have been recorded in the past at the Logansport gauge,[436] which is to be the gauge at which the Stateline flow is to be determined under the compact.[437] Apparently, all Texas reservoirs on which construction was started after January 1, 1953, and which lie in the Sabine watershed will be required to contribute water to help maintain a flow of 36 cubic feet per second, even if the flow that would "naturally" reach the gauge would be less than 36 cubic feet.[438]

Before discussing the way in which the waters are apportioned between the states, it is necessary to set forth certain additional definitions of terms as used in the compact:[439]

---

[431] L.S.A.—R.S. 38:2329.

[432] L.S.A.—R.S. 38:2329, Sabine River Compact, Article I (a). The compact provides that "Stateline" as defined therein shall not be construed to define the actual boundary between the two states and that nothing in the compact shall constitute an admission by either state regarding its actual location.

[433] L.S.A.—R.S. 38:2329, Sabine River Compact, Article IV.

[434] Id, Article X.

[435] Id, Article V (b) (1).

[436] Marsh, *Reports on the Surface Water Supply of Louisiana, to September 30, 1938*, Department of Conservation, Louisiana Geological Survey (In cooperation with United States Department of the Interior, Geological Survey), p. 138.

[437] L.S.A.—R.S. 38:2329, Sabine River Compact, Article 1 (c).

[438] But "no reservoir shall be liable for a greater percentage of this minimum flow than the percentage of the drainage area above the Stateline contributing to that reservoir, exclusive of the watershed of any reservoir on which construction was started prior to January 1, 1953." L.S.A.—R.S. 38:2329, Sabine River Compact, Article V (b) (3).

[439] L.S.A.—R.S. 38:2329, Sabine River Compact, Article I.

> The term "Waters of the Sabine River" means the waters eithe originating in the natural drainage basin of the Sabine River, o appearing as streamflow in said River and its tributaries, from it headwater source down to the mouth of the River where it enter into Sabine Lake . . .
>
> The term "Stateline reach" means that portion of the Sabine Rive lying between the Stateline and Sabine Lake . . .
>
> The term "Domestic use" means the use of water by an individual or by a family unit or household for drinking, cooking, laundering, sanitation, and other personal comforts and necessities; an for the irrigation of an area not to exceed one acre, obtained directly from the Sabine River or its tributaries by an individua or family unit, not supplied by a water company, water district, o municipality . . .
>
> The term "stock water use" means the use of water for any an all livestock and poultry . . .
>
> The term "consumptive use" means use of water resulting in it permanent removal from the stream . . .
>
> The terms " 'domestic' and 'stock water' reservoir" mean any re ervoir for either or both of such uses having a storage capacity fifty (50) acre-feet or less . . .
>
> "Stored water" means water stored in reservoirs (exclusive of d mestic or stock water reservoirs) or water withdrawn or release from reservoirs for specific uses and their identifiable return flo from such uses . . .
>
> The term "free water" means all waters other than "stored waters in the Stateline reach including, but not limited to, that appea ing as natural streamflow and not withdrawn or released from reservoir for specific uses. Waters released from reservoirs for th purpose of maintaining streamflows (at Stateline)[440] shall "free water." All reservoir spills or releases of stored waters mad in anticipation of spills, shall be free water.

The basic provision for the apportionment of the waters is that a "free water" in the Stateline reach is to be divided equally betwee the two states.[441] Each state has the right to withdraw its share of th water from the channel of the Sabine River, but all points of diversio must be recorded and approved by the Sabine River Compact Admi istration (discussed below) as well as "the State agency charged with th administration of the water laws" of the state in which the diversio point is located.[442] It is further provided that:

> Neither State shall withdraw at any point more than its share the flow at any point except, that pursuant to findings and d termination of the administration as provided under Article V of this Compact, either State may withdraw more or less of its sha

---

[440] Authors' insertion.

[441] Id, Article V (a).

[442] Id, Article VII (g) (5).

> of the water at any point provided that its aggregate withdrawal shall not exceed its total share.[443]

Except for jointly stored water (discussed below), each state must withdraw its apportionment of the freewater flow as it occurs with no allowance of accumulation of debits or credits. A failure to use the apportioned share does not constitute a relinquishment of the right to future use, nor does it give the right to future use in excess of the apportioned share.[444]

> Waters stored in reservoirs constructed by the States in the Stateline reach shall be shared by each State in proportion to its contribution to the cost of storage. Neither State shall have the right to construct a dam on the Stateline reach without the consent of the other State.[445]

The states may vary the rate and manner of withdrawal of their shares of these jointly stored waters. They may not, however, withdraw more than their pro-rata share in any one year except by authority of the administration.[446]

In the apportionment of waters, domestic and stock water uses are excluded, as are domestic and stock water reservoirs.[447] If either state builds reservoir storage on the tributaries of the Sabine located wholly within its boundaries and below the stateline, any reduction in the flow of the Sabine resulting from such storage is deducted from the state's share of the waters; conversely, any increase in the Sabine's flow from released water from these reservoirs is added to the state's share.[448]

In summary, it appears, that each state is entitled to half of the flow of the Sabine from the Stateline to Sabine Lake. Taken into account in determining this share is the effect on the flow of any storage of water on the tributaries that enter the river below the Stateline. Waters used for domestic and stock water uses are ignored.

---

[443] Id, Article V (f).

This sentence would seem to imply that a state is limited in its withdrawals to half of the free water flow at any particular point of withdrawal, with the exception that the administration may find and determine that at any particular point one state may withdraw more than this amount, so long as its aggregate withdrawals do not amount to more than its share. In other words, it would seem that the sentence was intended to provide for administration authorization of withdrawals amounting to more than a state's share at any particular withdrawal point. There appears, however, to be one possible difficulty with this interpretation; which is, that, as far as the authors have been able to determine, there is no provision in Article VII empowering the administration to make such a determination. Because of this, it is possible that the sentence means merely that a state may withdraw more than its share at any particular point if the findings of the administration are that the withdrawal will not place the aggregate withdrawal of the state at more than its share. In other words, possibly a state might withdraw any amount of water at any particular point so long as it does not exceed its total aggregate withdrawals as determined by the administration.

[444] L.S.A.–R.S. 38:2329, Sabine River Compact, Article V (i).

[445] Id, Article V (g).

[446] Id, Article V (h).

[447] Id, Article V (j).

[448] Id, Article V (d).

Except for the provision relating to storage of water on tributarie
there appears to be no provision relating to the states' use of the wate
of these tributaries, nor to the division between the two states of thes
waters. It is possible, however, that the same provisions that app
to the Sabine itself apply also to its tributaries. Article V of the con
pact begins with the phrase, "Texas and Louisiana hereby agree upo
the following apportionment of the waters of the Sabine River . .
"Waters of the Sabine River" are defined in Article I, set forth abov
to include the tributaries of the Sabine. This, along with the abov
quoted statement at the outset of the compact, indicates that the i
tention of the compact is to apportion the waters of tributaries as we
as the waters of the Sabine. But no later provision clearly spells o
that tributaries are to be apportioned between the states. Article V
does provide that any point of diversion on the tributaries and t
Sabine River must be approved by the administration,[449] and this wou
indicate that the waters of the tributaries are to be treated as t
Sabine River itself. Possibly then, the intention of the compact
that tributaries are also to be divided equally between the states
the same way as the Sabine.

The administration is officially entitled the "Sabine River Co
pact Administration." It consists of two members from each state a
of one nonvoting member chosen by the President of the United Stat
to represent the Federal government. This member is ex-officio chairm
of the administration. The Director of the Louisiana Department
Public Works serves as an ex-officio member; the other member is
resident of the Sabine Watershed and is appointed to a four-year term.

The administration has the power to make regulations consiste
with the provisions of the compact.[451] It can employ such personnel i
cluding engineering and legal personnel, as it deems necessary.[452] It
to collect and analyze all factual data necessary or proper for the adm
istration of the compact, including streamflows, water uses and div
sions, supplies, and storage.[453] It is to investigate all violations of t
compact and report its findings to the states as it deems fitting. It c
acquire and hold all property necessary for the performance of its fu
tions and duties under the compact.[454]

Findings of fact made by the administration are not conclusive
any court, agency, or tribunal, but unless they are satisfactorily rebutt
they constitute evidence.[455] A quorum for any meeting consists of th
voting (state) members, each of whom has one vote. Each decision
determination requires the concurring vote of three members.[456]

---

[449] Id, Article VII (g) (5).

[450] Id, Articles VII (a) to VII (c).

[451] Id, Article VII (f) (1).

[452] Id, Article VII (f) (3).

[453] Id, Article VII (f) (1), (g).

[454] Id, Articles VII (g) (7) and (8).

[455] Id, Article VII (i).

[456] Id, Article VII (e).

In case of a tie vote, arbitration is provided for. Each side is to choose an arbitrator, and the third is to be chosen by the two arbitrators. If the arbitrators fail to select a third arbitrator within 10 days, he shall be chosen by the representative of the United States.[457]

It is explicitly provided in the compact that all rights to any of the waters which have been obtained in accordance with the laws of the state are recognized and affirmed. It is further provided, however, that withdrawal of water for the satisfaction of such rights is subject to the availability of supply in accordance with the apportionment of water provided under the compact.[458] Apparently, then, riparian rights are not to be affected by the compact, except that the taking of water under these rights cannot be so great as to use up more than the share apportioned to the state. It is further provided that withdrawals by the states shall not impair or prejudice the existing rights of users of Sabine River waters.[459] It is not clear whether these provisions protecting riparian rights extend to allowing new diversion by riparian owners without the administration's approval of the diversion point as provided for in Article VII.[460] In any event, it appears that private uses of water legally exercised prior to enactment of the compact are not to be infringed upon except to the extent that they might amount to a use of more than the state's share of the waters.

In the course of its operations, the administration has issued a permit to the city of Logansport to use water from the Sabine River, following a similar permit by the Sabine River Authority. (See *Sabine River Authority.*) It has also collected and maintained information on the various existing uses of water from the river and its tributaries.

Other Interstate Agreements and Arrangements

Another interstate compact into which the state of Louisiana has entered (along with Florida, Mississippi, Alabama, and Texas) is the Gulf States Marine Fisheries Compact. The purpose of this compact is to promote the better utilization of the fisheries of the seaboard of the Gulf of Mexico.[461]

In 1955, Congress specifically authorized the states of Louisiana, Texas, Arkansas, and Oklahoma to negotiate with respect to the formulation of an interstate compact providing for an equitable apportionment of the waters of the Red River and its tributaries. Such negotiations were in progress in January 1959.[462]

Polluted water coming into the state from other states has been the source of some difficulty in Louisiana.[463] No interstate compact with respect to the control of such pollution had been entered into b Louisiana as of January 1959.[464] Some action has been taken, howeve under the Federal Water Pollution Control Act.[465] In addition to pr viding for Federal financial assistance and technical services to state interstate agencies, and municipalities for pollution abatement, this a provides that the Federal government may take action to secure th abatement of the pollution of interstate waters in certain circumstance The act is administered by the Surgeon General of the Public Healt Service, under the supervision of the Secretary of Health, Education, an Welfare.

---

[457] Id, Article VII (j).

[458] Id, Article III.

[459] Id, Article V (f).

[460] Id, Article VII (g) (5).

[461] See L.S.A.–R.S. 56:41 et. seq.

[462] 69 Stat. 654.

[463] See *Water Problems in the Southeastern States,* Louisiana Legislative Council Research Study No. 11 (Dec., 1957), pp. 23-27.

Whenever the U. S. Surgeon General, "on the basis of reports, su veys, or studies, has reason to believe" that the pollution of intersta waters is occurring,[466] or if requested by a governor or state water po lution control agency, "he shall give formal notification" to the sta water pollution control agency (or any interstate agency) of the sta or states in which the pollution is discharged and shall call a confe ence of the agencies in the respective states. After such conference, he believes that the health or welfare of persons in another state endangered and effective progress is not being made to abate su pollution in the state in which the pollution is discharged, he sha recommend that necessary remedial action be taken by the appropria water pollution control agency. If appropriate steps are not taken withi a specified time, the U. S. Secretary of Health, Education, and Welfa is to call a public hearing to be held before an appointed board in near the area in which pollution originates. The board shall determi whether appropriate steps have been taken to abate the pollution an if not, it may recommend reasonable and equitable measures to be ca ried out. If measures reasonably calculated to abate the pollution a not carried out within an additional specified time after proper noti to the persons discharging the polluting material and the appropria state agency or agencies, the Secretary (with the written consent appropriate agencies or officials in the state in which the pollution discharged or at the request of appropriate agencies or officials in a of the states affected thereby) may request the U. S. Attorney Gener to bring a suit on behalf of the United States to secure abatement the pollution.

---

[464] The Federal Water Pollution Control Act encourages and permits negotiati of such interstate compacts, although they shall not be binding on any state until " proved by the Congress."

[465] 62 Stat. 1155 (1948), as amended by 70 Stat. 498 (1956); 33 U.S.C.A. sec. et. seq.

[466] Interstate waters are defined for this purpose as "all rivers, lakes ,and ot waters that flow across, or form a part of, boundaries between two or more State The pollution of interstate waters in *or adjacent to* any state or states (whether polluting material is discharged directly into such waters or reaches such waters af discharge into a tributary thereof), which endangers the health or welfare of p sons in another state shall be subject to abatement as provided in the act.

The State Stream Control Commission and others in Louisiana requested the Federal government to intervene in connection with the pollution of the Corney Creek drainage system. Corney Creek arises in Arkansas and flows into Louisiana, then through Corney Lake and Corney Bayou into Bayou D'Arbonne, which flows into the Ouachita River. A five-member Hearing Board appointed by the Secretary of Health, Education, and Welfare held a hearing at Homer, La., on January 16, 1957. It found that certain operators of oil-well leases were "discharging substantial quantities of salt brines of an acid nature, oil spillage, and other substances" into the drainage system n Arkansas, "flowing through said system into Louisiana, thereby producing excessive and abnormal salinity and abnormally low pH value n said waters, causing and contributing to the pollution thereof . . ." The board found that such discharges were destroying large numbers of fish and other aquatic plants and animals and made the waters unfit for fishing, recreation, stock watering, irrigation, and municipal and most ndustrial uses. The board concluded that such pollution should be stopped and recommended that this be accomplished by injecting the polluting substances into underground formations.[467] The board's recommendation has been complied with by the offenders.[468]

---

[467] The board noted that this method of disposal was "being successfully used by a substantial majority of the other operators of . . . oil well leases in the watershed of said Corney Drainage System." See *Findings and Recommendations of the Hearing Board in the Matter of Pollution of the Interstate Waters of the Corney Drainage System, Arkansas-Louisiana.* See also *Water Problems in the Southeastern States,* upra, note 463, at pp. 26-27.

[468] Based on information supplied by Murray Stein, Chief, Interstate Enforcement Section, Water Supply and Water Pollution Control Program, Public Health Service, U.S. Dept. of Health, Education, and Welfare. For a summary of activities in the United States under the Federal Water Pollution Control Act. see Mr. Stein's paper ntitled "Cleaning Up Our Water," presented at the Briefing Conference on Water Resources, sponsored by the Federal Bar Association in cooperation with the Bureau of National Affairs, Inc., held on May 22-23, 1958, in Washington, D. C.

Appendix

Some Provisions of the Louisiana Civil Code and Revised Statutes Relative to Water That Are Frequently Cited in This Bulletin

L.S.A.—Civil Code, Article 450

Things which are common, are those the ownership of which belong to nobody in particular, and which all men may freely use, conformabl with the use for which nature has intended them such as air, runnin water, the sea and its shores.

L.S.A.—Civil Code, Article 660

It is a servitude due by the estate situated below to receive th waters which run naturally from the estate situated above, provide the industry of man has not been used to create that servitude.

The proprietor below is not at liberty to raise any dam, or to mak any other work, to prevent this running of the waters.

The proprietor above can do nothing whereby the natural servitu due by the estate below may be rendered more burdensome.

L.S.A.—Civil Code, Article 661

He whose estate borders on running water, may use it as it run for the purpose of watering his estate, or for other purposes.

He through whose estate water runs, whether it originates there passes from lands above, may make use of it, while it runs over h lands; but he cannot stop or give it another direction, and is boun to return it to its original channel, where it leaves his estate.

L.S.A.—Revised Statutes, 9:1101

The waters of and in all bayous, rivers, streams, lagoons, lakes ar bays, and the beds thereof, not under the direct ownership of any pe son on August 12, 1910, are declared to be the property of the stat There shall never be any charge assessed against any person for t use of the waters of the state for municipal, industrial, agricultural, domestic purposes.

While acknowledging the absolute supremacy of the United Stat of America over the navigation on the navigable waters within t borders of the state, it is hereby declared that the ownership of t water itself and the beds thereof in the said navigable waters is vest in the state and that the state has the right to enter into possession these waters when not interfering with the control of navigation ex cised thereon by the United States of America. This Section shall n affect the acquisition of property by alluvion or accretion.

All transfers and conveyances or purported transfers and conve ances made by the state of Louisiana to any levee district of the sta of any navigable waters and the beds and bottoms thereof are here rescinded, revoked and canceled.

This Section is not intended to interfere with the acquisition in go faith of any waters or the beds thereof transferred by the state or agencies prior to August 12, 1910.

ASSESSMENT of RURAL PROPERTIES in NORTH CENTRAL LOUISIANA

Clyde St. Clergy & Floyd L. Corty

Agricultural Experiment Station
Charles W. Upp, Director
Louisiana State University and
Agricultural and Mechanical College

etin No. 538
March 1961

FINDINGS

I. Based on 1,116 rural properties transferred between 1953 and 1958, assessments per acre for rural lands in six North Louisiana hill farm parishes in 1959 were:

Land Class	Bienville	Claiborne	Jackson	Lincoln	Union	Webster
Class A	$15.00	$17.75	$11.00	$14.00	$10.00	$16.00
Class B	10.00	10.00	11.00	11.00	8.00	11.00
Class C	8.00	8.00	8.00	8.00	6.00	8.50
Pasture	7.00	8.00	7.00	5.00	6.00	6.50
Miscellaneous	18.00	7.00	.....	4.25	5.00	14.60
Other Pine	7.00	*	5.00	*	5.00	6.50
Cutover Pine	5.00	*	5.00	4.00	.....	5.00

*Most forest lands in Claiborne and Lincoln parishes were assessed as miscellaneous land.

II. During the period 1953-58, about 48 percent of the rural tracts were being assessed at from 10 to 20 percent of sale value. Seventeen percent of the tracts were assessed below this range and 35 percent were in excess of this range.

III. Low value properties were assessed at higher rates than the more expensive properties. In fact, those valued at $2,000 were assessed at a ratio two and a half times as high as properties valued at $8,000 or more.

IV. The rate of assessment on homestead exempt properties valued at $2,000 or less was found to be three times as high as the rate of assessment on non-exempt properties of the same value.

V. Assessors apparently show no particular favoritism to owners in different occupational groups.

VI. Absentee owners are not being penalized by higher assessments. Their assessments compare favorably with those imposed on owner-occupied properties.

TABLE OF CONTENTS

Introduction 3
Objectives of the Study 3
Procedure 4
Assessment Inequalities 5
  Assessment Goals 5
  Assessment Related to Sale Value of Property 5
  Assessment Related to Occupation of Landowner 8
  Assessment of Exempt and Non-Exempt Properties 8
  Assessment on Properties Having Absentee Landlords 8
Basis for the Property Tax 8
Land Use Classification 13
Conclusions and Recommendations 16

Assessment of Rural Property In North Central Louisiana

C. J. St. Clergy and F. L. Corty*

Introduction

The general property or ad valorem tax is one of the oldest sources of revenue utilized by government. In colonial times this form of taxation was used solely by the Federal government. As settlement expanded westward, the property tax became rather difficult to administer and more difficult to enforce and it eventually was handed over to state governments. In course of time, however, most state governments found more lucrative sources of revenue and largely relinquished this form of taxation to local governments.

Since the property tax is a major source of revenue for local governments, any diminution in the tax base presents a problem of major proportions. This is the current predicament facing local government agencies, particularly in the North Louisiana Hill Farm Area, an area which formerly was agricultural and is now reverting rapidly to forest use. This change to a less intensive use implies that theoretically the income producing ability of the land is lower and, therefore, the value of the land should diminish proportionately. Actually, this reduction in value may not occur. It has been observed that land in this area is bid up in price, not because of its agricultural productivity but mainly because of non-agricultural demand, primarily subsurface mineral development. Under the present classification system, however, when land is taken out of agriculture and reverts to forestry, the forest land is valued somewhat below the poorest agricultural land in the same parish. Furthermore, with assessments based upon class use instead of the actual value of land, the system, as will be shown later, has the effect of reducing the tax base in the North Louisiana Hill Farm Area.

Objectives of the Study

The general objective of this study was to examine *rural property assessments* in North Central Louisiana. More specifically, the study had these objectives in mind:

1. To ascertain whether the present method of arriving at assessed values of properties is in accordance with requirements set forth by the Louisiana Constitution.
2. To determine whether the present assessment system results in inequities to taxpayers.

---

*Graduate Assistant, North Louisiana Hill Farm Experiment Station, and Assistant Professor, Department of Agricultural Economics, LSU.

FIGURE 1.—Land values are rising, not because of agricultural productivity, but partially because of subsurface development.

3. To examine the influence of the Homestead Exemption Law upon the rate of assessment of exempt and non-exempt properties.
4. To determine whether assessors show any favoritism to particular occupational groups.
5. To determine whether absentee owners are being penalized by higher assessments.
6. To make recommendations that may encourage and promote more equitable assessment of taxable rural properties.

Procedure

All land transfers of 10 acres or more, for the years 1953 through 1958, were noted from records of the Clerk of Court of the parishes of Bienville, Claiborne, Lincoln, Jackson, Union and Webster. The observations were confined to true sales between a willing buyer and a willing seller, omitting also transactions among relatives. The assessed values of the transferred tracts of land were then obtained from the assessors' records.

The assessment-sales ratio method of analysis was used. The assessment-sales ratio expresses the relation of the assessed value of a property to the sale value of the property. Wide differences in assessment-sales ratios indicate considerable inequality of assessments among taxpayers. On the other hand, uniform assessment-sales ratios indicate a more equitable treatment among taxpayers.

Assessment Inequalities

Assessment Goals

Table 1 shows that there was very little variation among the average assessment-sales ratios computed for each of the six parishes. It must be remembered, however, that these reflect averages for individual parishes and do not show the variation of assessment-sales ratios among individual tracts. Furthermore, assessment inequalities are less glaring when lands are assessed at a small fraction of actual cash value. For example, assessments at 20 and 15 percent of full value, respectively, do not sound as much out of line as the same proportion expressed as 80 and 60 percent, respectively.

It is readily apparent from data presented in Table 1 that land is being assessed at somewhat less than one-fifth of its actual cash value. Nevertheless, assessing land at less than actual cash value does not result in inequities if all lands in the tax district are assessed at the same percentage of actual cash value. It is important to note, however, that since a general state tax of 5¾ mills is in force, all assesors throughout the state should assess at the same percentage of full value. If not, property owners in parishes with high rates of assessment will pay more than their share and those in low assessment districts less than their fair share of the tax.

TABLE 1.—Weighted Average Rate of Assessment, Six North Louisiana Parishes, 1953-58

Parishes	Rate of Assessment	Property Transfers
	(Percent of Sale Value)	(Number)
Bienville	19	227
Claiborne	16	143
Jackson	13	176
Lincoln	16	143
Union	13	277
Webster	13	150
Average and Total	15	1,116

Assuming that assessors in each of the six parishes were attempting to assess land between 10 and 20 percent of its sale price, they correctly assessed 48 percent of the tracts sold. They underassessed 17 percent of the tracts, and overassessed 35 percent of the tracts (Table 2).

Assessment Related to Sale Value of Property

Table 3 shows the inequities of assessments, particularly on the basis of sale value of the property. In the six-parish area, properties with a sales value of $2,000 were assessed at a ratio two and a half times as high as properties with sales value at $8,000 or more. This

TABLE 2.—The Proportion of Tracts Sold in Six North Louisiana Parishes, Classified as to Rate of Assessment, 1953-58

Rate of Assessment	Bienville	Claiborne	Jackson	Lincoln	Union	Webster	All Six Parishes
			(Percent of Tracts)				
0 - 9	4	14	19	16	23	25	17
10 - 19	43	43	59	54	52	43	48
20 - 29	29	25	14	15	14	16	19
30 - 39	11	7	2	7	2	5	6
40 - 49	7	7	3	3	3	3	4
50 - 59	1	1	..	3	1	1	1
60 - 69	2	1	1	..	1	2	1
70 - 79	1	1	..	1	1	1	1
80 - 89	..	..	1	..	1	1	1
90 - Over	2	1	1	1	2	3	2
Total	100	100	100	100	100	100	100

TABLE 3.—Weighted Average Rate of Assessment as Related to Property Values, Six North Louisiana Parishes, 1953-58

Value per Property	Rate of Assessment						
	Bienville	Claiborne	Jackson	Lincoln	Union	Webster	All Six Parishes
(Dollars)				(Percent of Sale Value)			
Under 2,000	30	26	20	27	21	27	26
2,000 - 3,999	20	19	16	16	17	20	18
4,000 - 5,999	20	14	10	16	13	11	15
6,000 - 7,999	13	12	10	14	12	13	12
8,000 & Over	14	10	10	12	8	9	10

TABLE 4.—Number of Properties by Homestead Status and Sales Value in Six North Louisiana Parishes, 1953-58

Sale Value of Property	Number of Properties													
	Bienville		Claiborne		Jackson		Lincoln		Union		Webster		All Six Parishes	
	Homestead	No Homestead	Homestead	No Homestead	Homestead	No Homestead	Homestead	No Homestead	Homestead	No Homestead	Homestead	No Homestead	Homestead	No Homestead
	(Number)													
Under $2,000	18	91	20	46	9	73	13	30	22	119	17	34	99	393
$2,000 - 3,999	11	43	12	22	8	42	7	37	23	60	23	25	84	229
$4,000 - 5,999	11	24	9	12	4	15	9	15	8	19	7	16	48	101
$6,000 - 7,999	1	11	6	7	6	8	4	16	4	8	3	6	24	56
$8,000 & Over	4	13	6	3	3	8	6	6	1	13	11	8	31	50
Total	45	182	53	90	30	146	39	104	58	219	61	89	286	830

TABLE 5.—Rate of Assessment Related to Occupation of Landowner, Six North Louisiana Parishes, 1953-58

Occupation	Rate of Assessment						
	Bienville	Claiborne	Jackson	Lincoln	Union	Webster	All Six Parishes
	(Percent of Sale Value)						
Farmer	9	12	8	18	9	11	13
Pulpwood Ind.	11	14	7	16	5	..	14
Lumber Ind.	12	19	9	16	7	14	12
Laborer	15	11	10	16	17	14	13
Merchant	15	20	11	10	11	17	13
Real Estate Agents, Bankers & Loan Agencies	18	26	..	11	8	..	17
Professional	20	18	11	14	10	12	13
Industrial Concerns	..	..	..	13	62	..	10
Public Employee	17	12	13	18	10	17	12

means that property owners of lower valued lands carry more than their fair share of the tax load, especially if they do not have homestead exemption. About 74 percent of the properties included in this study had no homestead exemption; in fact a large proportion of the tracts had no dwellings on the place. Table 4 shows the number of observations occurring in each property value class and the number having homestead exemption.

Assessment Related to Occupation of Landowner

Apparently assessors in the six-parish area cannot be accused of showing favoritism to any particular occupational group. There was only slight evidence to suggest perhaps that professional or business groups may be assessed at a higher ratio than farmers, laborers or wood industries, but this could be attributed to the lower-valued tracts owned by these groups rather than the occupation of the owner (Table 5).

Assessment of Exempt and Non-Exempt Properties

Comparison of assessment-sales ratios between homestead exempt and non-exempt properties shows that exempt property is usually assessed at a higher level than non-exempt property. Exempt property valued at $2,000 or less was assessed at 46 percent of its actual cash value, while non-exempt property was assessed at only 14 percent of its actual cash value (Table 6). As the value of the property increased, the difference between exempt and non-exempt properties decreased. The Homestead Exemption Law provides for an exemption not to exceed $2,000 of assessed value, and the parishes are reimbursed by the state for the amount of the tax due from those properties on the tax rolls that qualify for exemption.

Assessments on Properties Having Absentee Landlords

At first glance it appears that owner occupied properties are assessed at a higher rate than absentee landlord properties (Table 7). This is true, but it must be remembered that practically all of the owner occupied properties carry a homestead exemption which eases the tax burden of the owner who lives on his property. Nevertheless, these data dispute the assertion that absentee owners are being penalized by higher assessments than those imposed upon owner occupied properties. Of the 1,116 properties included in this study, 17 percent were owner occupied, in 73 percent the owner lived within 50 miles of the property, and for 10 percent the owner lived more than 50 miles distant.

Basis for the Property Tax

The property tax as a means of obtaining revenue is based on two major concepts. The first is that property ownership constitutes a good measure of a person's ability to pay. This concept was de-

TABLE 6.—Comparison of Rate of Assessment for Homestead Exempt and Non-Exempt Properties, Six North Louisiana Parishes, 1953-58

Value per Property	Rate of Assessment							
	Bienville		Claiborne		Jackson		Lincoln	
	Exempt	Non-Exempt	Exempt	Non-Exempt	Exempt	Non-Exempt	Exempt	Non-Exempt
(Dollars)	(Percent of Sale Value)							
Under 2,000	63	23	29	25	45	17	42	19
2,000 - 3,999	23	19	24	16	39	11	22	15
4,000 - 5,999	26	18	14	14	15	9	19	14
6,000 - 7,999	11	12	13	12	12	8	17	13
8,000 & Over	12	15	9	13	14	8	15	10

Value per Property	Rate of Assessment					
	Union		Webster		All Six Parishes	
	Exempt	Non-Exempt	Exempt	Non-Exempt	Exempt	Non-Exempt
(Dollars)	(Percent of Sale Value)					
Under 2,000	54	14	40	8	46	14
2,000 - 3,999	32	11	24	16	27	14
4,000 - 5,999	22	9	9	12	19	13
6,000 - 7,999	16	10	22	9	15	11
8,000 & Over	9	7	6	13	10	10

TABLE 7.—Average Rate of Assessment on Owner Occupied Properties and Absentee Landlord Properties, Six North Louisiana Parishes, 1953-58

Location of Owner	Rate of Assessment					
	Bienville	Claiborne	Jackson	Lincoln	Union	Webster	All Six Parishes
	(Percent of Sale Value)						
Living on the Property	17	13	9	17	23	16	16
Absentee							
1-50 Miles	14	15	10	14	11	14	13
Over 50 Miles	15	12	9	12	10	14	12

veloped in early times, when most of the wealth was held in the form of tangible goods. The second concept is that property owners within a taxing district receive most of the benefits of local government and should be willing to pay for these advantages; for example, fire and police protection, improved highways, educational and recreational facilities, hospitals and other services which enhance property values. Arguments have frequently been advanced, both pro and con, to point out that both of these concepts may be in error. Nevertheless, until a better method of obtaining revenue for local governmental services is developed, the general property tax will remain in use.

In Louisiana, as in the majority of other states, the base on which the tax is applied is supposedly the actual cash value of the property. Article X, Section 12 of the Louisiana Constitution states that "all real estate, exempt as well as taxable, shall be valued at actual cash value, listed on the assessment rolls and submitted to the Louisiana Tax Commission." Despite this very clear and concise statement, neither the Constitution nor any statutes regarding the general property tax suggest a practical method for determining actual cash value. Chapter I, Section 1702 of the Louisiana Revised Statutes defines "actual cash value," or "actual cash valuation," as "the valuation at which any real or personal property is assessed for the purpose of taxation, after the assessing authorities have considered every element of value in arriving at such valuation. The price at which any piece of real estate or personal or movable property shall have been sold for cash in the ordinary course of business, free of all encumbrances, otherwise than at forced sale, shall be evidentiary only, and be considered with other factors in determining the actual cash value for assessment purposes."[1] This definition insists that other elements of value should be considered in arriving at the actual cash value but mentions only sale price. The other elements are left to the imagination of the assessor.

Is it not logical to assume that the person buying the property had considered the elements of value in arriving at a price he was willing to pay? This may be sufficient justification for basing the assessment upon sale price. However, this may not be the complete solution. Some properties may not change ownership for several generations. This is generally true for the larger, wealthier estates. In fact, land sales within certain assessment districts are becoming the exception rather than the rule.

Since there is no specific regulation or statute outlining a method for establishing cash value, assessors obviously are faced with an extremely difficult task.

Sample evidence indicates that the assessed value very rarely approaches the sale value of a piece of property. Apparently assess-

---

[1] State of Louisiana, Louisiana Revised Statutes of 1950: Baton Rouge, West Publishing Company, p. 316.

FIGURE 2.—Former cotton fields are now pasture, but land value have doubled. Assessed value may be reduced because of change to lowe class use.

ments are maintained at a low level because of the political pressures exerted by the taxpayers. It would be undesirable for an assessor to adjust his assessments upward unless it was part of concerted effort in which all assessors in the state attempted to d the same thing. A lone effort would merely result in an unfai burden on taxpayers in his district. This problem arises from th fact that the state imposes a uniform tax rate on all tax districts therefore, districts with higher rates of assessment would be at disadvantage.

Ordinarily, the rate of assessment is not a critical issue, becaus of the method used to determine the tax rate. First, the tax rate i determined by computing the amount of money needed for operating expenses and other purposes during the coming year; second money is formally appropriated for this purpose; and third, a property tax is levied for that portion of the total budget which is t be financed by property taxes. The amount of the tax levy is the divided by the total assessed value of the tax district to get the ta rate for the year. For example, a local unit with a total assesse value of $5 million and a tax levy of $60,000 would have a tax rat equal to 1.2 percent of its assessed value ($60,000 divided by $ million—.012). This tax rate is referred to as a millage rate—1 mills in this example—because it represents the number of mills t be collected for each dollar of assessed valuation. Therefore, th taxpayers' land can have a low value placed upon it with an accompanying high millage rate, or a high value with a low millage rate.

In Louisiana, however, the Constitution has established legal limits not to be exceeded by local millage rates. In many of the tax districts in Louisiana local millage rates have been at the maximum for years, and government officials no longer compute a new millage rate each year. They are forced to either supplement the budget with other revenues or curtail their activities.

Land Use Classification

Land use classification for assessment purposes seems to be of growing importance. In 1954, classification of forest land in Louisiana was enacted as a constitutional provision.[2] Classification of other land is not required by statute, but the Tax Commission directs assessors to classify rural non-forested lands into either Class A, Class B, Class C, pasture, or miscellaneous.

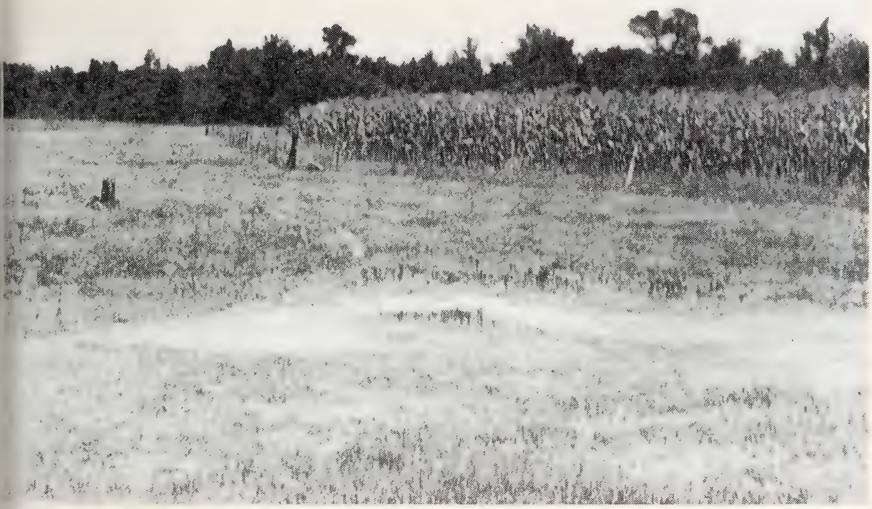


FIGURE 3.—Is this class A, B, or C agricultural land?

Placing land into various classes does not mean that all land falling within a specific class should have the same assessed value. In fact, the Constitution, in regards to forest land, and the assessment suggestions in the Biennial Report of the Louisiana Tax Commission specifically state that lands in the same class may have different values.[3] In Article X, Section 1 of the Constitution we find this statement: "After the effective date of this amendment no additional value shall be added to the assessment of land by reason of the presence of timber thereon in excess of such value as was included in the assessment of said land and timber thereon at the time of the adoption of this amendment; provided that standing timber shall be and remain liable equally with the land on which it stands, for ad valorem taxes levied on said land."[4]

---

[2] Section I, Article X, Constitution, State of Louisiana, as amended, 1954.

In the Biennial Report we find the following: "Different tracts of land may be placed in the same class and yet have different value."

Nevertheless, it is apparent from sample data and also from conversations with tax commissioners that an assessor is encouraged, in fact directed, to place the same value on all land in his district that has the same use classification. The initial values determined for each land use class within each parish is left to the discretion of the parish assessor. Table 8 shows the assessed values placed upon land classified as "Other Pine Land" and sold during 1953-58. It is apparent that 95 percent of "Other Pine Land" in Bienville is assessed at from six to eight dollars, 94 percent in Claiborne from seven to eight dollars, 83 percent in Jackson from five to six dollars, 98 percent in Union at five dollars, and 97 percent in Webster at six to seven dollars.

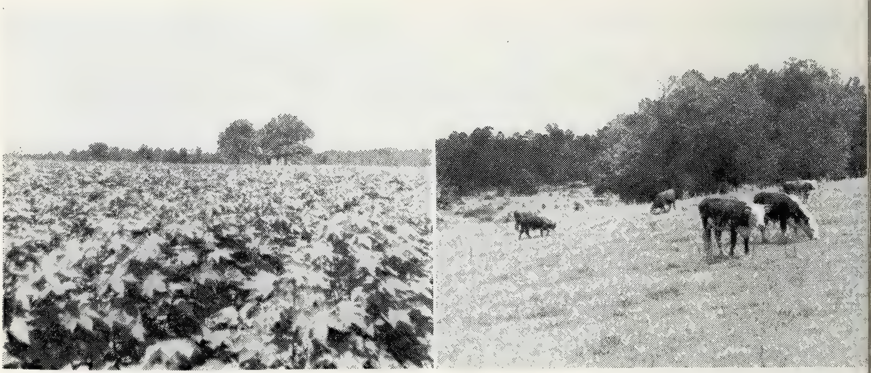


FIGURE 4.—The assessed value of this cotton land may be only $5 to $10 higher than the assessed value of this pasture land.

Use of a classification system with fixed assessment values for each class has two problem effects. First, it arbitrarily raises or lowers the assessed value of the land. As an example, a tract of land valued on the open market at $50 per acre for use as pasture is assessed at $8 per acre under the pasture classification. A timber company desiring the land for pine production purchases the land at $50 per acre and puts it into timber production. Under the classification system now in use, the land would be classed as "Other Pine Land" and assessed at $5 per acre instead of the former $8 per acre.

---

[3] Ninth Biennial Report of the Louisiana Tax Commission, 1958-59, p. 80.

[4] Constitution, State of Louisiana, 1921, as amended through the election of November 2, 1954, p. 250.

TABLE 8.—Assessment Value per Acre on Sample Tracts Classified as Other Pine Land, Five North Louisiana Parishes, 1958-59[1]

Assessment per Acre of Other Pine Land	Bienville	Claiborne	Jackson	Union	Webster
(Dollars)			(Percent of Tracts)		
10-13	1	..	7	..	..
9	3	3	5	..	..
8	30	18	5	..	..
7	41	76	..	1	6
6	24	3	22	1	91
5	1	..	61	98	1
4	..	..	..	..	2
	100	100	100	100	100

[1] Lincoln Parish did not have land classified as "Other Pine Land" on the assessment rolls.

The second problem effect is that a classification system with predetermined assessment values ignores the ad valorem property tax theory based on actual value. Land falling within the same use classification does not necessarily have the same value. Referring again to the Other Pine Land classification, it has been demonstrated by foresters that there is a great deal of variation in the productive capacity of various tracts of land which is frequently overlooked by the casual observer. These differences in productive ability of the soil undoubtedly influence the price that timber producers and others are willing to pay for a tract of land. Furthermore, the location of the tract with respect to good roads also affects the harvesting costs and, consequently, influences the price that timber producers are willing to pay for the land.

To disregard the great variation in value of various tracts of land of the same use classification is to disregard the basic concept of the ad valorem property tax. If it is assumed that the sale price of land is a good indicator of its cash value, it can be readily demonstrated that assessments based on land use instead of land values could possibly result in serious inequities and a diminution of the tax base.

Conclusions and Recommendations

The use of the classification system helps to standardize assessments according to land use but it also creates additional problems and inequities. Assessments made according to land use rather than land values are in direct violation of the constitutional provisions regarding property taxation.

The Tax Commission, in suggesting standardized values according to land use, is trying to attain uniform assessments within each tax district. Nevertheless, inequities are inherent in this requirement. For example, lands having the same sale value may be used for agricultural production or allowed to remain idle. The farmer who works his land in an effort to earn a living will pay a higher tax on his land than the absentee landlord who finds it convenient to let his land lie idle. To reduce these inequities the Tax Commission should insist that assessors follow the intent of the law and assess land at its actual cash value or at some uniform percentage thereof.

Results of this survey indicate that assessors of the various taxing districts are trying to maintain an average assessment rate of between 10 and 20 percent of cash value. This effort appears to be about 50 percent successful.

Trying to achieve uniformity of assessments on a state-wide basis is a tremendous task—like trying to drive a herd of 70 horses down a poorly defined lane. And the only justification, apparently, for maintaining this state-wide uniformity is to avoid inequities among taxing districts. These inequities among parishes occur because of the 5¾ mill property tax levied by the state against each taxable property. A taxing district assessing at 20 percent of full value would be paying twice as much per dollar of full value as the district assessing at 10 percent.

If assessors were encouraged to assess each property at its realistic cash value, individual inequities could be reduced within each tax district. If some assessors preferred to continue operating as in the past, a wide variation in rates of assessment could occur among districts. This latter discrepancy could well be handled by imposing the state levy upon an equalized assessment value for the parish rather than upon each taxable property.

Equalization could be accomplished in a manner similar to that used in New York State. For example, let's assume four parishes with average rates of assessment of 10, 15, 20 and 30 percent, respectively, and corresponding assessment values of $40 million, $30 million, $20 million and $30 million. The equalization computation would be as shown in Table 9.

Note that the average rate of assessment for the four parishes is 15 percent. This rate times the full value for each parish gives the equalized value. Note also that the total equalized value equals the total assessed value. An equitable apportionment of the tax load among parishes results when the state tax is imposed upon the equalized value rather than upon the original assessed value. Thus it would appear desirable to place the 5¾ mill state tax levy on the equalized parish assessment instead of on every individual property.

The wide variation in rate of assessment within a taxing district continues to be a difficult problem. Undoubtedly, each assessor is well aware of the discrepancies within his district. He knows that he is not assessing at full value and that some adjustments are needed in recognition of changing property values over the years.

TABLE 9.—Example of Equalization of Assessed Values Among Parishes

Parish	Rate of Assessment	Total Assessed Value	Full Value	Equalized Value
	(Percent)	(Million Dollars)		
A	10	40	400	60
B	15	30	200	30
C	20	20	100	15
D	30	30	100	15
Average and Total	15	120	800	120

Properties change in value in somewhat irregular patterns. A few select properties may skyrocket in value because of some locational advantage; for example, an oil discovery or a community subdivision. Still other properties may diminish in value because of nearness to some nuisance factor, a garbage dump, for example. Despite these value changes, there is a considerable reluctance on the part of assessors to raise or lower assessments in line with changing values. Why? Well, first of all, they are only human. An increase in assessments invites considerable opposition. Individual landowners rebel when this occurs, and their attitudes are vividly reflected by voting for a replacement at the next election. There is no incentive to lower assessments where justified, because it would merely distort the tax base and call attention to the need for adjusting other assessments upward to compensate for the loss in revenue which otherwise would occur. Hence, the general practice is to maintain the status quo as much as possible, to raise assessments only on newly formed property units, and lower assessments only when landowners file a justifiable request for an adjustment.

Some states have solved the political pressure problem by having assessors appointed and placed under Civil Service. This is one way of encouraging assessors to make adjustments without fear of political retaliation.

Another suggested improvement is to reduce the cost of preparing the annual assessment roll and facilitate record keeping by placing property data on punch cards for machine processing. Some of the more progressive taxing districts in other states have already switched over to this system.

Regardless of the approach to be followed, the burden rests with the taxpayers. The existing assessment problems have resulted mainly from apathy and shortsighted self interests. There is an apparent need for frank and open discussions in both rural and urban areas to acquaint landowners with assessment and taxing practices.

A Comparison of Three Sources of PHOSPHORUS

By Harold E. Harris

Louisiana State University
and
Agricultural and Mechanical College
Agricultural Experiment Station
Charles W. Upp, Director

Bulletin No. 539 April 1961

Table of Contents

INTRODUCTION 3

REVIEW OF LITERATURE 3

EXPERIMENTAL PROCEDURE 8

EXPERIMENTAL RESULTS AND DISCUSSION 11

SUMMARY AND CONCLUSIONS 31

LITERATURE CITED 33

A Comparison of Three Sources of Phosphorus

HAROLD E. HARRIS

Introduction

In Louisiana, particularly in the western part of the state where the production of livestock is becoming one of the important agricultural enterprises, the improvement and management of pastures are being given primary consideration. The soils of this area are low in nitrogen, calcium, and other bases, and are extremely low in phosphorus. These soils commonly support undesirable grasses and weeds which are able to thrive at a low fertility level. Most of these species are less palatable to livestock and yield less than the desirable species. These conditions result in lower carrying capacity of the pastures and higher cost of livestock production.

Studies have been made at the West Louisiana Experiment Station to determine what fertilization and liming practices are necessary for the establishment of improved pastures. In general, the results show that phosphorus is the limiting factor in pasture development. In addition to phosphate fertilization, liming is necessary to bring about a proper soil reaction, and in some cases other factors have to be taken into account. Therefore, a major step in pasture improvement is to apply sufficient available phosphorus for the growth of desirable pasture plants. In solving this problem, the question of what phosphate fertilizer will be the most efficient for this purpose becomes important.

The purpose of this investigation was to determine the relative efficiency of three sources of phosphate fertilizers in increasing the yield and improving the protein and mineral contents of forage from a mixture of rye grass, white clover, and Dallis grass.

Review of Literature

The effects of phosphate fertilization on the yield or production of pasture grasses and legumes have been studied in detail by a number of investigators. Fewer studies of the effects of applied phosphate on the chemical composition of pasture crops have been made.

The yield and chemical composition of pasture plants in general have been shown to vary greatly in relation to species, soil fertility, stage of plant maturity, and weather conditions. Most pasture plants contain a higher percentage of protein and minerals in the early growth stages. As the plants mature, the percentage of these constituents decreases and the quality of the forage progressively declines.

A number of experiments have been conducted by the Virginia Experiment Station in which superphosphate and rock phosphate were compared. The results of these experiments have been summarized by Rich and Lutz (33). Two phosphate materials were compared on an equal P_2O_5 basis. The data showed that most crops did not respond as well to rock phosphate as they did to superphosphate. However, the yields of all crops were relatively high without the use of any phosphate.

Woodhouse (42) summarized the data from North Carolina showing the value of rock phosphate in comparison with superphosphate. He concluded that rock phosphate was inferior to superphosphate when applied on an equal basis. Two to seven times as much phosphorus was required in the form of rock phosphate to give a response equal to that of superphosphate.

In three pasture experiments in Mississippi, Anthony (2) reported that rock phosphate applied at twice the rate of P_2O_5 as in superphosphate increased yields 47 per cent, compared with 68 per cent for superphosphate. Lyon (23) conducted a field test in New York on Dunkirk silty clay loam in which superphosphate applied at one-fourth the rate of P_2O_5 applied as rock phosphate produced as much increase in yield as rock phosphate.

Moores (28) summarized the results of a 3-year rotation for a 10-year period of an experiment in which superphosphate and rock phosphate were compared at several rates. An average of all crops showed that superphosphate was the more effective source on both limed and unlimed soils. Lime decreased the effectiveness of rock phosphate appreciably.

DeTurk (15) stated that free calcium carbonate may retard the intake of phosphorus from rock phosphate by plants which are not "strong feeders." He did not recommend, however, that lime be omitted where rock phosphate is used. Legumes that are "strong feeders" on rock phosphate need lime, and as a result the advantage of using lime along with rock phosphate in a legume rotation may exceed any early reduction in the yield of non-legumes. It is evident that only enough lime should be added to satisfy the needs of the legumes.

Thorne (37) concluded that superphosphate proved to be a more effective as well as a more economical source of phosphorus than rock phosphate where freight rates are a relatively large part of the cost of the materials. He also stated, "Where a different outcome has resulted, it is usually found that one or both of the phosphate carriers have been used in such large quantities as to furnish more available phosphorus than the crops were able to utilize, thus making a comparative measurement of the effect of the two carriers impossible." Since rock phosphate is cheaper per unit of P_2O_5 than superphosphate, it is often applied at two to four times the rate of P_2O_5 used for superphosphate.

Murdock and Seay (30), in experiments with red clover and wheat, found that the amount of available phosphorus from rock phosphate is increased by increasing the rate of application. About 3.5 to 4.0 times as much rock phosphate as superphosphate is needed to give equal yields and plant phosphorus contents when the phosphorus sources are applied separately. Volk (40) found that the yields of oats and sorghum and the total calcium and phosphorus absorbed by the plants were much greater for superphosphate than for rock phosphate.

Long (22), in comparison of rock phosphate with triple superphosphate, found that the yield of red clover was only 75 per cent that obtained from triple superphosphate when rock phosphate was applied at 2.5 times the P_2O_5 equivalent of the triple superphosphate.

Neller and Lundy (31), in studies of the availability of residual phosphorus from superphosphate and rock phosphate, found that 40 per cent of the phosphorus in an oat crop was obtained from residual phosphorus of superphosphate applied at 100 pounds of P_2O_5 per acre. Pretreatment with 300 pounds of P_2O_5 per acre resulted in more than 60 per cent uptake of phosphorus from residual phosphate. For oats in 1950, and for fescue in 1951, the uptake from residuals of finely ground rock phosphate at 640 pounds of P_2O_5 per acre was equal to that from superphosphate applied at 100 pounds of P_2O_5 per acre. The use of rock phosphate resulted in decreases in yields and in percentage of phosphorus in the crops, as compared with superphosphate.

McLean, Brown, and Hawkins (26), in comparative evaluation studies on rock and superphosphate, found that over long periods of time crops grown on soils receiving rock phosphate may eventually yield as well as those grown on soils receiving superphosphate. However, for short periods of time the crops treated with superphosphate definitely outyield those receiving rock phosphate as the only source of phosphorus.

Larson, Nelson, and Hunter (21) conducted field and laboratory studies on extremely deficient soils to determine the effects of different rates of superphosphate on yield and phosphorus composition of oats and alfalfa and to evaluate the residual effects of initial application of phosphorus over a number of years. Superphosphate was applied broadcast and disced into the soil in the spring of 1946 at rates of 0, 30, 60, 120, and 240 pounds of P_2O_5 per acre. The phosphate applications greatly increased the phosphorus content of the oats and alfalfa. By 1949, the 240-pound application of P_2O_5 was still responsible for large yield increases.

Cheaney, Weihing, and Ford (10) reported the first four years (1950-1953) of data from an experiment to determine the effects of various rates and frequencies of application of rock phosphate and superphosphate on the yield and chemical composition of pasture forage on a Lake Charles clay loam soil. The amounts of P_2O_5 in pounds per acre from each source and frequency of fall application of this amount were 30 pounds every year, 60 pounds every 2 years, 120 pounds every 4 years, 240 pounds every 8 years, and 480 pounds every 16 years. At the end of the fourth year, four yearly 30-pound applications and two 60-pound applications of P_2O_5 from superphosphate had equalled and surpassed the production from single applications of 120 and 240 pounds of P_2O_5 from the same source. There appeared to be a similar trend with rock phosphate; however, the yearly 30-pound application had not proved very effective.

The chemical composition of pasture forage may be influenced by several factors. Existing data indicate that the most important causes of such differences are age of plant, species present, soil fertility, climatic conditions, and competition from other plants. It is well known that there are variations in the composition of plants at different stages of growth. Beeson (6) indicated that, in general, the nutritive elements attain maximum concentrations during the early life of the plant.

Daniel and Harper (13) found that nitrogen and phophorus are high in the young plants and decrease toward maturity. The total calcium in the plants increases at first, then decreases at a slower rate than the phosphorus and nitrogen as the plant matures. Hart and Guilbert (19) of the California station reported that the protein, calcium, and phophorus in range grasses decrease with maturity.

Fraps and Fudge (17) found that the phosphorus and protein contents decreased considerably and lime increased in most of the species as the plants passed from the early vegetative stage through blooming and maturity. The relative change in composition differed considerably, however, with different species. The average protein content ranged from 5.37 to 9.10 per cent in the early stage, from 3.89 to 7.20 per cent in the bloom stage, and from 3.64 to 7.30 per cent at maturity.

Armstrong (4) found that the herbage of a pasture varies botanically to a considerable extent during the season, the variation being determined largely by soil and weather. He also found that from the early part of June onward the percentage of nitrogen and phosphorus in the forage of a pasture gradually decreases, while the proportion of dry matter increases.

The relative production of pastures in terms of animal growth depends not alone on quantity of forage produced but also on quality. Vinall and Wilkins (39) stated that the application of fertilizer to Kentucky bluegrass caused significant increases in protein, calcium, and phosphorus. The application of phosphorus to the soil increased the phosphorus and calcium of both grass and white clover.

From a standpoint of nutritive value, the mineral content of forage crops is highly important. This is especially true with phosphorus, which for the country as a whole is more often than any other element a limiting factor in nutritional requirements for grazing livestock and for crop production.

Beeson (7) and Mitchell (27) pointed out that the most prevalent and widespread nutritional inadequacy among farm animals is phosphorus.

Crampton (11) stated that calcium and phosphorus contents of individual pasture species can be altered by fertilizer treatment. However, he believed that the nutritive value of the forage is not necessarily affected by such differences. Beeson (6) concluded that phosphorus fertilizers can slightly increase the concentration of phosphorus in most species used for forage, particularly where the original phosphorus concentration in the plant is usually low. He pointed out that the phosphorus concentration in the plant, related to application of phosphates to the soil, depends to a large degree on the nature of the soil.

Singleton, Nelson, and Stanberry (35) found that the phosphorus content of alfalfa was increased by 79 per cent and the yield of hay by up to 50 per cent through the application of phosphate fertilizers at an average annual rate of 48 pounds of P_2O_5 per acre to phosphorus-deficient soils.

Alway and Nesom (1) concluded that, in farm practice, phosphorus fertilizers applied on phosphorus-deficient soils usually caused an appreciable increase in the protein content of alfalfa hay. They were able to show an increase of 1 per cent in crude protein as a result of phosphate fertilization in western Minnesota. This is almost double the increase in crude protein reported by Singleton, Nelson, and Stanberry (35), who conducted their trials on phosphorus-deficient soils.

Crampton and Findlayson (12) made extensive pasture trials. They concluded that some factor or factors other than quantitative differences in total protein, fiber, or minerals such as calcium and phosphorus, of the rations must cause differences in the nutritive value of pastures fertilized with lime and phosphate.

Maynard (24) stated that the deleterious effects of low phosphorus occur acutely where dry matter contains 0.12 per cent phosphorus or less. He considered that with forage as the sole feed for livestock during periods of maximum demands, such as growth or lactation, the phosphorus content of the forage should be at least 0.30 per cent.

A number of other investigators have considered that the minimum requirements of beef cattle may be met by a somewhat lower forage phosphorus content. Watkins (41) considered that forage with a phosphorus content of 0.113 per cent would have sufficient phosphorus to meet minimum requirements of beef cattle during the summer months. He stated that forage containing less than 0.113 per cent phosphorus was deficient for beef cattle. Forage containing 0.113 per cent to 0.151 per cent was considered to have a medium phosphorus content; and forage containing over 0.151 per cent was considered high in phosphorus from the standpoint of the nutrition of beef cattle. A forage phosphorus content of 0.093 per cent was considered the minimum winter requirement for beef breeding cows.

Black, Tash, Jones, and Kleberg (9) considered a forage phosphorus content of 0.13 per cent necessary to meet the minimum requirement for beef cattle. Savage and Heller (34) accepted the figure of 0.13 per cent forage phosphorus as the minimum requirement for beef cattle.

Davis (14) stated that in areas where phosphorus is supplied entirely by a pasture program, the minimum level of phosphorus in the forage should be between 0.17 and 0.20 per cent.

Beeson, Bolin, Hickman, and Johnson (8) found that rations containing from 0.11 to 0.15 per cent phosphorus were deficient for growing and fattening steer calves. A ration containing 0.18 per cent phosphorus was adequate to meet the requirements of fattening steers. Guilbert, Gerlaugh, and Madsen (18) also recommended higher phosphorus allowances for beef cattle. They considered that cows nursing calves should have a forage containing not less than 0.18 per cent phosphorus. This percentage in the ration will also be adequate for normal growth of heifers and steers except for those in the 400 to 600 pound weight range.

Davis (14) stated that the level of calcium in the forage below which a deficiency would be assumed must be somewhat arbitrary, inasmuch as beef cattle are less susceptible to a calcium deficiency condition than are dairy cattle in lactation. He concluded that levels below 0.20 per cent calcium on a dry weight basis are inadequate for milking cows, and 0.10 per cent calcium was considered as a minimum that will support even poor beef cattle husbandry.

Henderson and Weakley (20) found that for growing dairy animals the minimum requirements for calcium is 0.35 per cent and for phosphorus 0.20 per cent. They found that whenever conditions existed which enabled bluegrass and white clover to crowd out poverty grass and other undesirable herbage, the calcium and phosphorus contents were well above 0.35 and 0.20 per cent, respectively.

Experimental Procedure

A pasture mixture consisting of Louisiana S-1 white clover, common rye grass, and Dallis grass was grown for two years and used to determine the effects of various rates and times of application of rock phosphate, ordinary superphosphate, and triple superphosphate on the yield, chemical composition, and nutritive value of the forage. The pasture mixture was grown at the West Louisiana Experiment Station, DeRidder, Louisiana, on a Bowie very fine sandy loam. The topography of the experimental area varied from 2 to 3 per cent slope. Little bluestem (*Andropogan scorparius*), big bluestem (*Andropogan gerardi*), and broom sedge (*Andropogan virginicus*) were the common grasses growing on the area before the experimental mixture was established.

Soil samples were taken to a depth of six inches in the experimental area prior to the fertilization of the plots.

Soil analysis showed that this soil was low in available phosphorus (6 parts per million), available potassium (35 p.p.m.), available calcium (200 p.p.m.), and available magnesium (58 p.p.m.). The soil had a pH value of 5.9.

A seedbed was prepared in the fall of 1952 by plowing, discing, and leveling the area.

Four blocks, each consisting of 10 plots completely separated by alleyways, were established in a randomized block design. Each plot measured 10 feet by 60 feet.

Fertilizer treatments involved the use of 33.5 per cent ammonium nitrate, 20 per cent ordinary superphosphate, 45 per cent triple superphosphate, 33 per cent rock phosphate, and 60 per cent muriate of potash. Ammonium nitrate and muriate of potash were applied annually each fall to all plots, except to the check plot, at rates of 24 pounds of nitrogen and 96 pounds of K_2O per acre. Dolomitic limestone was applied before seeding in 1952 at the rate of 4,000 pounds per acre to all plots except the check plots and those receiving a treatment of rock phosphate as indicated below. The different phosphate treatments were as follows:

check (no fertilizer or lime)
15 pounds P_2O_5 per acre from triple superphosphate annually
30 pounds P_2O_5 per acre from triple superphosphate annually
60 pounds P_2O_5 per acre from triple superphosphate annually
120 pounds P_2O_5 per acre from triple superphosphate annually
300 pounds P_2O_5 per acre from triple superphosphate first year only
300 pounds P_2O_5 per acre from ordinary superphosphate first year only
300 pounds P_2O_5 per acre from rock phosphate first year only
600 pounds P_2O_5 per acre from rock phosphate first year only
600 pounds P_2O_5 per acre from rock phosphate first year only (no lime)

The lime was dropped from a fertilizer spreader onto the plots after seedbed preparation. The nitrogen, phosphate, and potash were then broadcast by hand on the plots, and the lime and mixed fertilizer were disced into the soil to a depth of approximately two inches.

Following the application of lime and fertilizers the plots were broadcast seeded with 5 pounds of Louisiana S-1 white clover and 25 pounds of common rye grass per acre. The area was then cultipacked to press the seed into the soil and to conserve moisture. A satisfactory stand of clover and grass was obtained in all the fertilized plots. In the check plots, the seed germinated and died within a short time. Dallis grass was broadcast seeded on the established sod at the rate of 10 pounds per acre in the spring of 1953. Again a successful stand was obtained in all plots except the check plot.

The forage harvested from the check plots, in all instances, consisted of native grasses and weeds. The entire area of each plot was clipped to a height of about two inches with a sickle type mower when there was enough growth to warrant harvesting to determine forage yields. Samples were taken from each replicated treatment at harvest to determine air-dry yields and chemical analysis. The samples were taken at random within each replication. An estimate was made of the percentage of grasses and legumes in the mixture at the time of sampling. The plants were placed in paper bags and allowed to air-dry. After the samples had been taken, the remainder of the vegetation was removed from the plots.

Air-dried plant material from the different replicates of the fertilizer treatments was ground to 20-mesh fineness in a Wiley mill. The replicates were combined and chemical analyses were made on one composite sample for each fertilizer treatment. A portion of each composite sample was dried in a forced draft oven at 105° C. for 12 hours, after which it was removed and placed in a dessicator and allowed to cool. Between 1 and 2 grams of the dry plant material were weighed on an analytical balance, placed into 250 ml. beakers, and covered with ribbed beaker covers. The plant samples were wet-ashed with nitric and perchloric acids according to the method developed by Toth, Prince, Wallace, and Mikkleson (38). Fifteen milliliters of concentrated nitric acid were added to the samples, and they were allowed to digest for 12 hours without heating. The samples were then placed on a hot plate at low temperature and allowed to digest until the solution was straw-colored. The samples were then removed from the hot plate and allowed to cool. After the samples had cooled, 10 ml. of 70 per cent perchloric acid were added to each sample. The samples were then placed on a hot plate and were allowed to evaporate at low temperature to almost dryness. This procedure was repeated with 1:1 nitric-perchloric acid until a clear color appeared, indicating that all of the organic matter had been removed. The samples then contained the mineral elements and silica.

The mineral elements and silica were taken up in 10 ml. of 5 N hydrochloric acid and heated to almost boiling. Ten milliliters of hot distilled water were added and the samples were immediately filtered through a No. 42 Whatman filter paper into 100 ml. volumetric flask. The samples were washed several times with hot distilled water and allowed to cool before bringing up to volume.

The above solution, labeled "Solution A," contained the calcium, phosphorus, magnesium, and potassium that were to be determined.

If exactly 1-gram samples of plant material had been used in the 100 ml. of "Solution A," the dilution factor of the solution would have been 100. Since between 1 and 2 grams of the plant material were used, it was necessary to calculate a dilution factor for each sample in order to determine the per cent of each element in the solution. The dilution factors were calculated as follows:

$$\text{Dilution factor (d.f.)} = \frac{100}{\text{Wt. of plant sample used}}$$

The calcium, magnesium, and potassium contents of the plant material were determined by the use of a Beckman Model DU Flame Spectrophotometer. The instrument settings for determining these elements are given in Table 1.

Standard solutions for calibration were made up in 0.5 N hydrochloric acid and contained the following concentrations of calcium, magnesium, and potassium: calcium, 0, 50, 100, 150, 200, and 250 p.p.m.; magnesium, 0, 10, 20, 30, 40, and 50 p.p.m.; potassium, 0, 50, 100, 150, 200, 250, 300, and 400 p.p.m. The unknowns were aspirated through the

TABLE 1.—Instrument settings for the Beckman Model DU Flame Spectrophotometer, for the determination of calcium, magnesium, and potassium

	Ca	Mg	K
Wavelength, Mu	422.1	382.2	765
Slit width, mm	0.15	0.2	0.04
Load resistor	2	2	3
Fuel:			
C_2H_2, psi	2.5		2.5
H_2, psi		2.5	
O_2, psi	10	10	10
Selector switch	0.1	0.1	0.1
Sensitivity	2	Full	Off
Zero supression	Off	Off	Off
Phototube	Blue	Blue (Knob out)	Red (Knob in)

flame, and the values read were compared with a standard curve. The parts per million and per cent of each mineral element determined in the plant material were calculated as follows:

p.p.m. Ca in plant = p.p.m. Ca in solution x d.f.

% Ca in plant = p.p.m. in plant x 0.001

Phosphorus was determined with the method developed by Dickman and Bray (16). One milliliter aliquots of the "Solution A" were transferred into 50 ml. volumetric flasks. After diluting the "Solution A" with approximately 35 ml. of distilled water, 10 ml. of 2.5 per cent ammonium molybdate solution in 10 N sulfuric acid and 5 ml. of dilute stannous choloride were added. The solution was made up to volume and agitated. A set of standards ranging from 0.1 to 0.5 p.p.m. phosphorus was prepared simultaneously. The color of each sample was allowed to develop for a minimum of 6 minutes and then the transmittency was read in a Fisher Electrophotometer using a 650 Mu filter. The amount of phosphorus present in the plant material was determined by reference to a standard curve.

The remainder of the composite air-dried samples were sent to the Feed and Fertilizer Laboratory of Louisiana Agricultural Experiment Station, where analyses were made according to the methods of the Association of Official Agricultural Chemists (5). The samples were analyzed for moisture, crude protein, ether extract or fat, nitrogen-free extract, fiber, and ash contents. The percentage of these constituents are reported on a moisture-free basis.

Experimental Results and Discussion

The results from the effects of different levels and sources of fertilizer phosphorus on the yield and chemical composition of the rye grass, Louisiana S-1 white clover, and Dallis grass pasture mixture are reported in Tables 2 through 7.

The forage yields for the two years 1953 and 1955 are given in Table 2 and are shown graphically in Figures 1, 2, and 3. The data for 1954

TABLE 2.—The effects of different sources and amounts of fertilizer phosphorus on the yield of a mixture of rye grass, Louisiana S-1 white clover, and Dallis grass on a Bowie very fine sandy loam

		Pounds dry matter per acre		
Treatments	Harvests	1953	1955	Total 1953 and 1955
No treatment	April		40	40
	June	133	761	894
	Sept.	1,142	116	1,268
	Total	1,275	917	2,192
15 lbs. P_2O_5/A. triple superphosphate annually	April	196	378	574
	June	637	1,474	2,111
	Sept.	1,206	200	1,406
	Total	2,039	2,052	4,091
30 lbs. P_2O_5/A. triple superphosphate annually	April	370	655	1,025
	June	708	2,102	2,810
	Sept.	1,119	244	1,363
	Total	2,197	3,001	5,198
60 lbs. P_2O_5/A. triple superphosphate annually	April	444	803	1,247
	June	698	1,720	2,418
	Sept.	1,229	252	1,481
	Total	2,371	2,775	5,146
120 lbs. P_2O_5/A. triple superphosphate annually	April	378	1,861	2,239
	June	1,032	2,283	3,315
	Sept.	1,238	319	1,557
	Total	2,598	4,463	7,111
300 lbs. P_2O_5/A. triple superphosphate 1st year only	April	554	1,023	1,577
	June	1,157	2,300	3,457
	Sept.	1,333	320	1,653
	Total	3,044	3,643	6,687
300 lbs. P_2O_5/A. ordinary superphos. 1st year only	April	1,940	1,313	3,253
	June	1,200	2,456	3,656
	Sept.	1,454	420	1,874
	Total	4,594	4,189	8,783
300 lbs. P_2O_5/A. rock phosphate 1st year only	April	307	467	744
	June	669	1,773	2,442
	Sept.	1,166	212	1,378
	Total	2,142	2,452	4,594
600 lbs. P_2O_5/A. rock phosphate 1st year only	April	568	804	1,372
	June	1,040	2,192	3,232
	Sept.	1,302	340	1,642
	Total	2,910	3,336	6,246
600 lbs. P_2O_5/A. rock phos. 1st yr. only (no lime)	April	444	611	1,055
	June	752	2,061	2,813
	Sept.	1,302	304	1,606
	Total	2,498	2,976	5,474
L.S.D. @ 5% level		1,161	880	1,861
L.S.D. @ 1% level		1,567	1,188	2,514

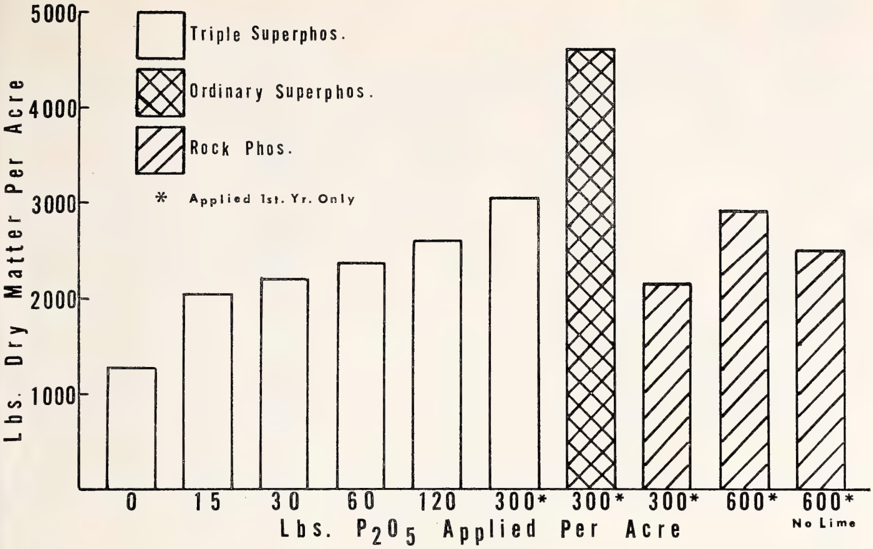


FIGURE 1.—The effects of the use of different sources and amounts of phosphorus on the yields from a mixture of rye grass, Louisiana S-1 white clover, and Dallis grass, 1953.

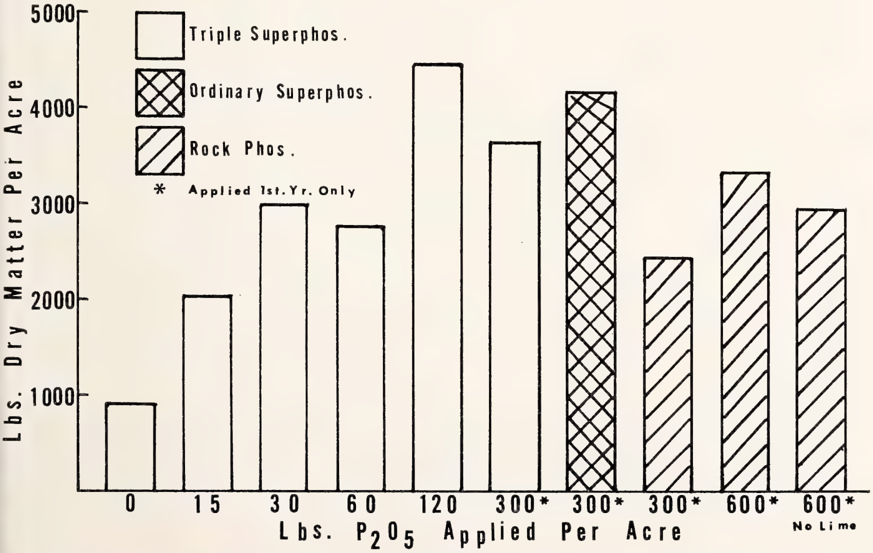


FIGURE 2.—The effects of the use of different sources and amounts of phosphorus on the yields from a mixture of rye grass, Louisiana S-1 white clover, and Dallis grass, 1955.

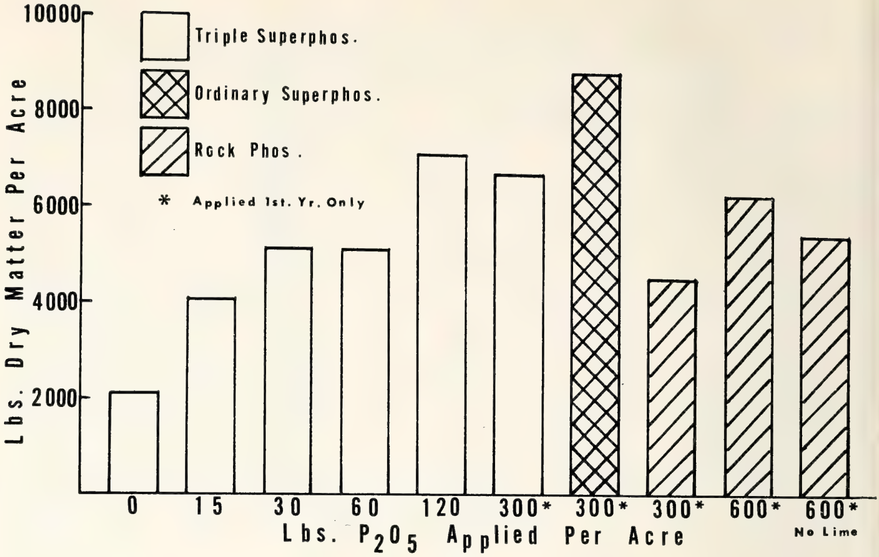


FIGURE 3.—The effects of the use of different sources and amounts of phosphorus on the yields from a mixture of rye grass, Louisiana S-1 white clover, and Dallis grass, for the years 1953 and 1955.

were omitted because of extremely low rainfall during most of the spring and summer seasons. The yields were low, and little differences were obtained among the different fertilizer treatments. The data reported for 1953 and 1955 were obtained under normal rainfall conditions.

Examination of the data in Table 2 shows that significant differences in dry matter production occurred among the different phosphate treatments. The differences are significant at both the 5 per cent and 1 per cent levels. In general, the dry matter production per acre increased as the amount of available P_2O_5 applied per acre was increased. It should be noted, however, that the rates of P_2O_5 are given in terms of total P_2O_5 applied per acre. The total P_2O_5 of ordinary and triple superphosphate is considered available; whereas in rock phosphate, only 10 per cent of the total P_2O_5 is considered available. In the case of the T.V.A. rock phosphate used in this experiment, 3 per cent of the material was available P_2O_5.

In 1953, the highest yield of dry matter obtained in the experiment was 4,594 pounds per acre from the application of 300 pounds of P_2O_5 from ordinary superphosphate (Table 2). The best yield of dry matter from rock phosphate was 2,910 pounds per acre from the application of 600 pounds of P_2O_5.

In 1955, the highest yield of dry matter was 4,436 pounds per acre from 120 pounds of P_2O_5 applied annually as triple superphosphate. A comparison of triple superphosphate and ordinary superphosphate at the 300 pounds of P_2O_5 level shows that ordinary superphosphate gave a significantly higher total of dry matter per acre for the two-year period (Table 2). This significantly higher yield obtained from ordinary superphosphate may be attributed partly to the presence of sulphur in this source of phosphorus. However, in other phosphate studies at this station, no increase in yields was obtained from the use of sulphur with triple superphosphate.

The highest total yield of dry matter among the rock phosphate treatments was obtained from 600 pounds of P_2O_5 per acre. This yield was lower than the yield from the better superphosphate treatment, indicating that more rock phosphate was needed for maximum production. For the two years combined, the highest total yield, 8,783 pounds per acre, in the superphosphate series was produced by the application of 300 pounds of P_2O_5 per acre from ordinary superphosphate (Table 2).

Rock phosphate applied at the rate of 600 pounds of P_2O_5 per acre appears to be comparable to triple superphosphate applied at the rate of 300 pounds of P_2O_5 per acre for forage production. In other experiments, ordinary superphosphate has been found to be superior to triple superphosphate or rock phosphate for forage production on soils at DeRidder.

The data in Table 2 indicate that more than 60 pounds of P_2O_5 per acre applied annually from superphosphate is needed to maintain yields of forage under meadow conditions.

Data in Tables 3, 4, and 8 show that the crude protein content of the forage varied with the season and with botanical composition. Generally, the crude protein of the forage was higher in the spring and early summer when a relatively large percentage of the forage was composed of legumes. The crude protein content of the forage at the three sampling dates ranged from high values in the vicinity of 10 to 15 per cent in April and June to low values of about 5 to 6 per cent in September. The forage collected from the check plots, which consisted of native grasses, was low in crude protein content throughout the growing season.

Morrison (29) states that the protein requirements of a mature pregnant cow weighing 900 pounds will not be met when protein in forage falls below 6 per cent. For beef cows during the lactating period a forage protein requirement of 9 per cent is suggested. This requirement is based on a crude protein digestibility of 60 per cent, and consumption by the cow of 18 to 20 pounds of dry matter daily.

Guilbert, Gerlaugh and Madsen (18) state that 5 per cent digestible protein in the ration is adequate, except for heifers and steers weighing less than 800 pounds, bulls, and fattening cattle. If the protein in the forage is considered 60 per cent digestible, the crude protein content of the forage should be approximately 8.3 per cent in order to provide an allowance that would be generally adequate.

The data in Tables 3 and 4 show the crude protein content of the forage from all treatments, except from the check plots, to be approximately equal to or above the recommended minimum for beef cattle in

Fifteen pounds P_2O_5 per acre from concentrated superphosphate annually.

Thirty pounds P_2O_5 per acre from concentrated superphosphate annually.

Sixty pounds P_2O_5 per acre from concentrated superphosphate annually.

One hundred and twenty pounds P_2O_5 per acre from concentrated superphosphate annually.

Three hundred pounds P_2O_5 per acre from rock phosphate first year only.

Six hundred pounds P_2O_5 per acre from rock phosphate first year only.

Six hundred pounds P_2O_5 per acre from rock phosphate first year only (no lime).

April and June. By September, however, the crude protein content of the forage from all plots was well below the required minimum.

The production of crude protein per acre was greater as the available P_2O_5 applied per acre was increased (Figures 4, 5, and 6). The percentage of crude protein in the forage did not necessarily increase, as shown by data in Tables 3 and 4. This greater production of crude protein as the available P_2O_5 applied per acre was increased was due to greater yield of dry matter.

The percentage of fat and ash in the forage was generally higher in April and June than in September. The fiber content of the plants increased as the season advanced and plants reached maturity.

As a general measure of the nutritive value of a feed, digestion coefficients are used to compute the content of total digestible nutrients (T.D.N.). Although data on the total digestible nutrients are not available, certain speculations may be made. By referring to Tables 3 and 4, it is evident that the crude protein content of the forage was increased by fertilization. In general, the crude protein content was higher when a large percentage of the forage was composed of legumes.

An attempt was made to evaluate forage quality as characterized by a carbohydrate-protein ratio. This ratio was calculated as follows:

$$\frac{\%\ \text{Nitrogen-free Extract} + \%\ \text{Crude Fiber}}{\%\ \text{Crude Protein}} = \text{Carbohydrate-protein Ratio}$$

The carbohydrate-protein ratios were narrower in the spring and summer, when the forage was relatively immature. The presence of

TABLE 3.—The effects of different sources and amounts of fertilizer phosphorus on the quality of a mixture of rye grass, Louisiana S-1 white clover, and Dallis grass on a Bowie very fine sandy loam, 1953

Treatments	Harvests	Composition of dry matter					Carbo. Prot. Ratio
		Crude Protein	Fat	Fiber	Ash	N-free Extract	
		%	%	%	%	%	
No treatment	April						
	June	6.29	1.76	34.20	7.74	50.01	13.39
	Sept.	5.80	2.13	33.88	7.55	50.64	14.57
15 lbs. P_2O_5/A. triple superphosphate annually	April	10.45	3.03	27.09	11.24	48.19	7.20
	June	9.90	1.76	29.75	10.73	48.05	7.86
	Sept.	5.52	2.13	36.12	6.90	49.74	15.55
30 lbs. P_2O_5/A. triple superphosphate annually	April	9.48	3.12	27.23	11.28	48.89	8.03
	June	10.42	1.61	30.06	9.73	48.18	7.51
	Sept.	5.84	1.76	34.88	8.54	48.98	14.36
60 lbs. P_2O_5/A. triple superphosphate annually	April	8.98	3.15	27.47	10.59	49.81	8.61
	June	10.75	1.54	30.64	10.34	46.76	7.20
	Sept.	5.56	2.11	34.62	8.64	49.07	15.05
120 lbs. P_2O_5/A. triple superphosphate annually	April	10.00	2.86	28.25	11.26	47.63	7.59
	June	13.74	1.59	28.23	10.88	45.56	5.37
	Sept.	5.30	1.64	36.16	8.40	48.50	15.97
300 lbs. P_2O_5/A. triple superphosphate 1st year only	April	9.01	2.93	28.60	12.33	47.13	8.41
	June	11.81	1.59	28.86	11.01	46.73	6.40
	Sept.	5.07	1.58	36.47	8.02	48.86	16.83
300 lbs. P_2O_5/A. ordinary superphosphate 1st year only	April	9.31	2.90	29.14	11.58	47.07	8.19
	June	14.89	1.56	28.10	11.93	43.52	4.81
	Sept.	5.29	1.41	35.87	8.78	48.65	15.98
300 lbs. P_2O_5/A. rock phosphate 1st year only	April	9.65	3.07	27.76	11.73	47.79	7.83
	June	9.80	1.44	28.30	10.76	49.70	7.96
	Sept.	5.62	1.60	36.01	8.63	48.14	14.97
600 lbs. P_2O_5/A. rock phosphate 1st year only	April	10.00	3.12	27.70	11.84	47.34	7.50
	June	12.01	1.51	28.37	11.10	47.10	6.28
	Sept.	5.41	1.70	35.81	8.65	48.43	15.57
600 lbs. P_2O_5/A. rock phosphate 1st year only (no lime)	April	9.19	3.19	28.44	11.45	47.73	8.29
	June	10.59	1.53	30.01	10.81	47.06	7.28
	Sept.	5.42	1.80	35.62	8.25	48.91	15.60

TABLE 4.—The effects of different sources and amounts of fertilizer phosphorus on the quality of a mixture of rye grass, Louisiana S-1 white clover, and Dallis grass on a Bowie very fine sandy loam, 1955

Treatments	Harvests	Composition of dry matter					Carbo. Prot. Ratio
		Crude Protein	Fat	Fiber	Ash	N-free Extract	
		%	%	%	%	%	
No treatment	April	8.90	1.04	30.12	10.92	49.02	8.89
	June	7.08	2.01	31.86	9.33	49.72	11.52
	Sept.	5.11	1.23	33.03	10.60	50.03	16.25
15 lbs. P_2O_5/A.	April	9.25	1.18	30.37	11.28	47.92	8.46
triple superphosphate	June	8.76	1.74	32.42	8.70	48.38	9.22
annually	Sept.	5.83	1.05	35.39	10.14	47.59	14.23
30 lbs. P_2O_5/A.	April	9.27	1.11	30.58	11.60	47.44	8.42
triple superphosphate	June	10.91	1.83	31.77	8.72	46.77	7.20
annually	Sept.	6.84	0.97	35.12	10.42	46.65	11.95
60 lbs. P_2O_5/A.	April	8.67	1.00	30.08	11.75	48.50	9.06
triple superphosphate	June	8.70	1.55	32.61	9.11	48.03	9.27
annually	Sept.	5.10	0.95	36.61	9.50	47.84	16.56
120 lbs.P_2O_5/A.	April	11.03	0.93	31.32	12.18	44.54	6.88
triple superphosphate	June	8.12	1.22	36.65	8.32	45.69	10.14
annually	Sept.	5.83	1.02	35.39	9.71	48.05	14.31
300 lbs. P_2O_5/A.	April	10.21	1.09	32.08	11.81	44.81	7.54
triple superphosphate	June	10.33	1.69	33.07	8.26	46.65	7.72
1st year only	Sept.	5.51	1.05	34.59	9.87	48.98	15.17
300 lbs. P_2O_5/A.	April	10.59	1.17	32.38	10.72	45.14	7.32
ordinary superphosphate	June	9.55	1.47	33.72	8.98	46.28	8.38
1st year only	Sept.	5.74	0.92	33.07	11.18	49.09	14.31
300 lbs. P_2O_5/A.	April	8.82	1.04	30.41	11.20	48.53	8.95
rock phosphate	June	9.88	1.82	32.14	8.57	47.59	8.07
1st year only	Sept.	6.03	1.07	33.74	10.89	48.27	13.60
600 lbs. P_2O_5/A.	April	9.20	1.13	30.17	11.68	47.82	8.48
rock phosphate	June	10.38	1.76	33.54	9.03	45.29	7.59
1st year only	Sept.	6.54	1.03	32.83	11.52	48.08	12.37
600 lbs. P_2O_5/A.	April	9.27	1.20	31.53	11.24	46.76	8.45
rock phosphate 1st year	June	10.60	1.85	31.99	9.15	46.41	7.40
only (no lime)	Sept.	5.94	1.15	34.55	9.33	49.03	14.07

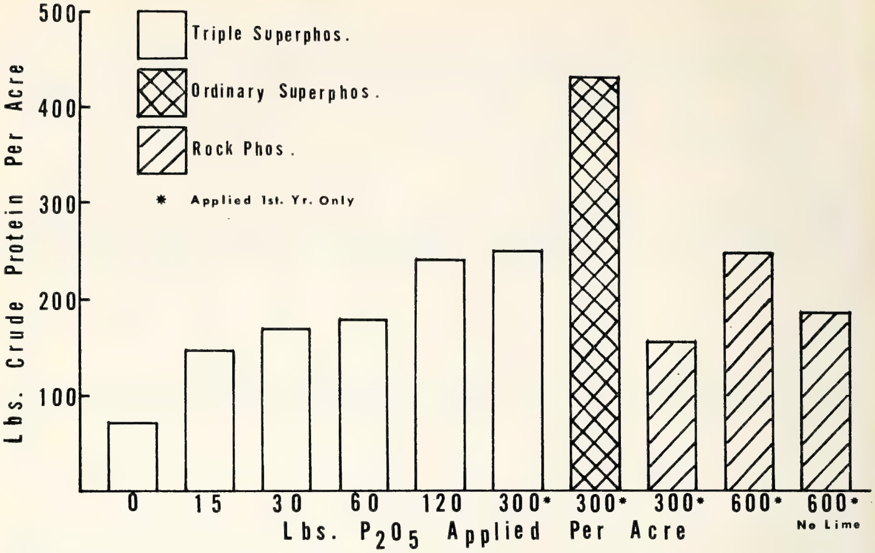


FIGURE 4.—The effects of the use of different sources and amounts of phosphorus on the production of crude protein in a mixture of rye grass, Louisiana S-1 white clover, and Dallis grass, 1953.

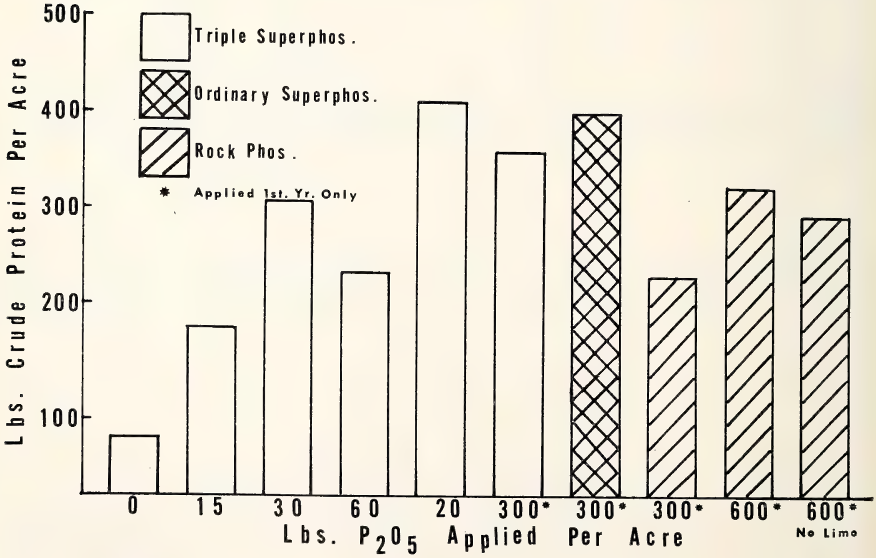


FIGURE 5.—The effects of the use of different sources and amounts of phosphorus on the production of crude protein in a mixture of rye grass, Louisiana S-1 white clover, and Dallis grass, 1955.

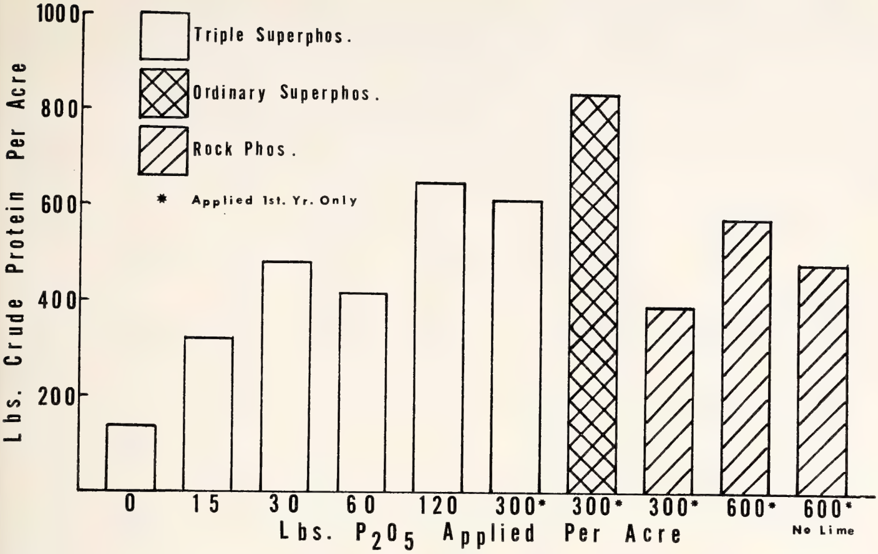


FIGURE 6.—The effects of the use of different sources and amounts of phosphorus on the production of crude protein in a mixture of rye grass, Louisiana S-1 white clover, and Dallis grass, 1953 and 1955.

legumes in the mixture also contributed to narrow ratios. Wide ratios were obtained in the fall, when the forage consisted of mature grasses. These wide ratios may be attributed to low protein and high fiber contents of the mature grasses. Maynard (25) states that as this ratio becomes wider, the digestibility of all nutrients tends to be lower. It is apparent from the data in Tables 3 and 4 that by September the forage from all plots was of poor quality.

The calcium, phosphorus, magnesium, and potassium contents of the forage harvested during different months for the two years are given in Tables 5 and 6, and a summary of the two years of data appears in Table 7.

The mineral contents of the forage for the different months differed greatly. The mineral contents of the forage from all treatments was generally higher in April and June than in September. The magnesium content of the forage varied less with season than did calcium, phosphorus, or potassium, which decreased in content with advance in season. This may be attributed to the stage of maturity and to changes in the botanical composition as shown in Table 8. The botanical composition of the clover-grass mixture showed abrupt changes with season. Thus, a considerable part of the chemical variation noted was assumed to be due to differences in the proportions of the several species, and their proportions were greatly influenced by the kind and amounts of fertilizer phosphate applied.

TABLE 5.—The effects of different sources and amounts of fertilizer phosphorus on the contents of magnesium, potassium, calcium, and phosphorus in a mixture of rye grass, Louisiana S-1 white clover, and Dallis grass on a Bowie very fine sandy loam, 1953

Treatments	Harvests	Composition of dry matter				Ca:P Ratio
		Mg	K	Ca	P	
		%	%	%	%	
No treatment	April					
	June	0.18	0.92	0.42	0.07	6.0
	Sept.	0.19	0.76	0.30	0.06	5.0
15 lbs. P_2O_5/A.	April	0.36	2.92	1.18	0.13	9.1
triple superphosphate	June	0.27	2.10	0.51	0.16	3.2
annually	Sept.	0.22	1.33	0.30	0.05	6.0
30 lbs. P_2O_5/A.	April	0.37	2.77	1.26	0.14	9.0
triple superphosphate	June	0.29	2.20	0.55	0.19	2.9
annually	Sept.	0.25	1.11	0.33	0.07	4.7
60 lbs. P_2O_5/A.	April	0.34	2.73	1.06	0.19	5.6
triple superphosphate	June	0.29	2.14	0.64	0.26	2.5
annually	Sept.	0.27	1.19	0.33	0.07	4.7
120 lbs. P_2O_5/A.	April	0.35	2.88	1.10	0.26	4.2
triple superphosphate	June	0.35	2.23	0.78	0.26	3.0
annually	Sept.	0.26	1.46	0.36	0.10	3.6
300 lbs. P_2O_5/A.	April	0.31	2.35	1.09	0.30	3.6
triple superphosphate	June	0.32	2.00	0.66	0.22	3.0
1st year only	Sept.	0.30	1.76	0.38	0.12	3.2
300 lbs. P_2O_5/A.	April	0.29	2.47	1.02	0.28	3.6
ordinary superphosphate	June	0.36	2.05	0.82	0.23	3.6
1st year only	Sept.	0.29	1.75	0.44	0.12	3.7
300 lbs. P_2O_5/A.	April	0.37	2.83	0.95	0.15	6.3
rock phosphate	June	0.31	1.84	0.55	0.14	3.9
1st year only	Sept.	0.27	1.34	0.30	0.09	3.3
600 lbs. P_2O_5/A.	April	0.40	2.74	1.36	0.17	8.0
rock phosphate	June	0.34	2.01	0.66	0.18	3.7
1st year only	Sept.	0.29	1.44	0.36	0.08	4.5
600 lbs. P_2O_5/A.	April	0.31	2.77	1.01	0.20	5.1
rock phosphate 1st year	June	0.28	2.11	0.67	0.23	2.9
only (no lime)	Sept.	0.24	1.45	0.33	0.11	3.0

In 1953, the growth in early season was primarily rye grass and white clover. The amount of clover present in the plots was dependent on the amount of available P_2O_5 applied per acre as shown in Table 8. In the late summer and early fall the vegetation was predominantly Dallis grass in all of the fertilized plots.

The invasion of lespedeza into the plots where the lower rates of available phosphorus were applied was evident in the fall of 1954 and was pronounced in the spring and summer months of 1955, when it made

TABLE 6.—The effects of different sources and amounts of fertilizer phosphorus on the contents of magnesium, potassium, calcium, and phosphorus in a mixture of rye grass, Louisiana S-1 white clover, and Dallis grass on a Bowie very fine sandy loam, 1955

		Composition of dry matter				Ca:P
Treatments	Harvests	Mg	K	Ca	P	Ratio
		%	%	%	%	
No treatment	April	0.31	1.59	0.74	0.08	9.3
	June	0.32	1.30	0.95	0.06	15.8
	Sept.	0.26	0.58	0.49	0.05	9.8
15 lbs. P_2O_5/A.	April	0.29	2.29	0.69	0.16	4.3
triple superphosphate	June	0.29	1.33	0.74	0.09	7.4
annually	Sept.	0.26	0.80	0.41	0.06	6.8
30 lbs. P_2O_5/A.	April	0.31	2.26	0.72	0.18	4.0
triple superphosphate	June	0.31	1.38	0.82	0.12	6.8
annually	Sept.	0.27	1.00	0.39	0.11	3.5
60 lbs. P_2O_5/A.	April	0.38	2.21	0.87	0.22	4.0
triple superphosphate	June	0.32	1.59	0.67	0.17	3.9
annually	Sept.	0.25	0.86	0.38	0.09	4.2
120 lbs. P_2O_5/A.	April	0.37	2.49	1.01	0.27	3.7
triple superphosphate	June	0.25	1.70	0.52	0.19	2.7
annually	Sept.	0.29	0.91	0.45	0.12	3.8
300 lbs. P_2O_5/A.	April	0.35	2.41	0.93	0.22	4.2
triple superphosphate	June	0.30	1.38	0.68	0.16	4.3
1st year only	Sept.	0.27	0.82	0.45	0.09	5.0
300 lbs. P_2O_5/A.	April	0.37	2.24	0.91	0.21	4.3
ordinary superphosphate	June	0.29	1.43	0.70	0.14	5.0
1st year only	Sept.	0.29	1.06	0.47	0.10	4.7
300 lbs. P_2O_5/A.	April	0.31	2.38	0.57	0.14	4.1
rock phosphate	June	0.32	1.42	0.74	0.10	7.4
1st year only	Sept.	0.28	0.88	0.44	0.07	6.3
600 lbs. P_2O_5/A.	April	0.34	2.42	0.66	0.17	3.9
rock phosphate	June	0.29	1.40	0.71	0.14	5.1
1st year only	Sept.	0.28	1.00	0.48	0.08	6.0
600 lbs. P_2O_5/A.	April	0.30	2.32	0.68	0.20	3.4
rock phosphate 1st year	June	0.27	1.50	0.79	0.15	5.3
only (no lime)	Sept.	0.25	0.96	0.50	0.07	7.1

up as much as 60 per cent of the vegetative growth (Table 8). The occurrence of lespedeza in these plots may be attributed to the spreading of seed through animal droppings in the area prior to the establishing of the test in fall of 1952.

The data in Table 8 for 1955 also show that in plots where there was a relatively high percentage of white clover in the spring a small percentage of lespedeza was present in the summer and fall. This may be associated with a higher phosphorus requirement for white clover, and

TABLE 7.—**The effects of different sources and amounts of fertilizer phosphorus on the contents of magnesium, potassium, calcium, and phosphorus in a mixture of rye grass, Louisiana S-1 white clover, and Dallis grass on a Bowie very fine sandy loam (Mean of 1953 and 1955)**

Treatments	Harvests	Composition of dry matter				Ca:P Ratio
		Mg	K	Ca	P	
		%	%	%	%	
No treatment	April	0.31	1.59	0.74	0.08	9.3
	June	0.25	1.11	0.69	0.07	9.9
	Sept.	0.23	0.67	0.40	0.06	6.7
15 lbs. P_2O_5/A. triple superphosphate annually	April	0.33	2.61	0.94	0.15	6.3
	June	0.28	1.72	0.63	0.13	4.8
	Sept.	0.24	1.07	0.36	0.06	6.0
30 lbs. P_2O_5/A. triple superphosphate annually	April	0.34	2.52	0.99	0.16	6.2
	June	0.30	1.79	0.69	0.16	4.3
	Sept.	0.26	1.06	0.36	0.09	4.0
60 lbs. P_2O_5/A. triple superphosphate annually	April	0.36	2.47	0.97	0.21	4.6
	June	0.31	1.87	0.66	0.22	3.0
	Sept.	0.26	1.03	0.36	0.08	4.5
120 lbs. P_2O_5/A. triple superphosphate annually	April	0.36	2.69	1.06	0.27	3.9
	June	0.30	1.97	0.65	0.23	2.8
	Sept.	0.28	1.19	0.41	0.11	3.7
300 lbs. P_2O_5/A. triple superphosphate 1st year only	April	0.33	2.38	1.01	0.26	3.9
	June	0.31	1.69	0.67	0.19	3.5
	Sept.	0.29	1.29	0.42	0.11	3.8
300 lbs. P_2O_5/A. ordinary superphosphate 1st year only	April	0.33	2.36	0.97	0.25	3.9
	June	0.33	1.74	0.76	0.19	4.0
	Sept.	0.29	1.41	0.46	0.11	4.2
300 lbs. P_2O_5/A. rock phosphate 1st year only	April	0.34	2.61	0.76	0.15	5.1
	June	0.32	1.63	0.65	0.12	5.4
	Sept.	0.28	1.11	0.37	0.08	4.6
600 lbs. P_2O_5/A. rock phosphate 1st year only	April	0.37	2.58	1.01	0.17	5.9
	June	0.32	1.71	0.69	0.16	4.3
	Sept.	0.29	1.22	0.42	0.08	5.3
600 lbs. P_2O_5/A. rock phosphate 1st year only (no lime)	April	0.31	2.55	0.85	0.20	4.3
	June	0.28	1.81	0.73	0.19	3.8
	Sept.	0.25	1.21	0.42	0.09	4.7

with plant competition between the clover and lespedeza in the early spring.

The addition of phosphorus to the soil increased the phosphorus content of the forage at all the rates of phosphorus tested (Tables 5, 6, and 7). In general, the percentage of phosphorus in the forage increased as the rate of available P_2O_5 applied per acre was increased. However, in 1953, which was the first crop year, the application of more than 120 pounds of P_2O_5 per acre from superphosphate gave very small increases

TABLE 8.—The effects of different sources and amounts of fertilizer phosphorus on the botanical composition of a mixture of rye grass, Louisiana S-1 white clover, and Dallis grass on a Bowie very fine sandy loam, 1953 and 1955

		1953		1955	
		Estimated Per Cent		Estimated Per Cent	
Treatments	Harvests	Legumes	Grasses	Legumes	Grasses
No treatment	April				100[5]
	June		100[5]		100[5]
	Sept.		100[5]		100[5]
15 lbs. P_2O_5/A.	April	5[1]	95[3]	10[1]	90[3]
triple superphosphate	June	20[1]	80[4]	25[2]	75[4]
annually	Sept.		100[4]	5[2]	95[4]
30 lbs. P_2O_5/A.	April	10[1]	90[3]	10[1]	90[3]
triple superphosphate	June	30[1]	70[4]	60[2]	40[4]
annually	Sept.		100[4]	15[2]	85[4]
60 lbs. P_2O_5/A.	April	10[1]	90[3]	20[1]	80[3]
triple superphosphate	June	30[1]	70[4]	15[2]	85[4]
annually	Sept.		100[4]		100[4]
120 lbs. P_2O_5/A.	April	15[1]	85[3]	50[1]	50[3]
triple superphosphate	June	60[1]	40[4]	5[2]	95[4]
annually	Sept.		100[4]		100[4]
300 lbs. P_2O_5/A.	April	10[1]	90[3]	40[1]	60[3]
triple superphosphate	June	50[1]	50[4]	20[2]	80[4]
1st year only	Sept.		100[4]	5[2]	95[4]
300 lbs. P_2O_5/A.	April	15[1]	85[3]	50[1]	50[3]
ordinary superphosphate	June	80[1]	20[4]	15[2]	85[4]
1st year only	Sept.		100[4]	5[2]	95[4]
300 lbs. P_2O_5/A.	April		100[3]	10[1]	90[3]
rock phosphate	June	15[1]	85[4]	40[2]	60[4]
1st year only	Sept.		100[4]	10[2]	90[4]
600 lbs. P_2O_5/A.	April	10[1]	90[3]	25[1]	75[3]
rock phosphate	June	30[1]	70[4]	40[2]	60[4]
1st year only	Sept.		100[4]	15[2]	85[4]
600 lbs. P_2O_5/A.	April	5[1]	95[3]	15[1]	85[3]
rock phosphate 1st year	June	15[1]	85[4]	50[2]	50[4]
only (no lime)	Sept.		100[4]	15[2]	85[4]

[1]White Clover, [2]Lespedeza, [3]Rye grass, [4]Dallis grass, [5]Native grass

in the phosphorus content of the forage. The phosphorus content of the forage from the rock phosphate treatments was slightly higher when no lime was applied. The percentage of phosphorus in the forage from the application of 600 pounds of P_2O_5 per acre from rock phosphate, without lime, was approximately equal to that from 60 pounds of P_2O_5 per acre from triple superphosphate applied annually.

There were considerable differences in the phosphorus uptake per acre among the different phosphate treatments, as shown in Figures 7, 8, and 9. The phosphorus uptake per acre from 300 pounds of P_2O_5 applied as ordinary superphosphate was considerably higher than that from 300 pounds of P_2O_5 applied as triple superphosphate. However, the percentage of phosphorus in the forage was about the same. The higher uptake of phosphorus per acre from the ordinary superphosphate was due to a higher yield. By 1955, the differences in yield between these two treatments were considerably less, and the phosphorus uptake per acre for the two treatments was almost equal (Figure 8). The phosphorus uptake per acre from the annual application of 120 pounds of P_2O_5 per acre from triple superphosphate surpassed that of the initial application of 300 pounds of P_2O_5 per acre from triple or ordinary superphosphate the third year. However, the highest total phosphorus uptake for the two years was obtained from ordinary superphosphate (Figure 9). The total phosphorus uptake per acre from initial application of 600 pounds of P_2O_5 per acre from rock phosphate, with and without lime, was equal to that from triple superphosphate applied at the rate of 60 pounds of P_2O_5 annually.

The results of the chemical analysis (Tables 5, 6, and 7) show that the phosphorus content in the forage was low enough to become deficient for the proper nutrition of beef cattle by September. Phosphorus in the forage may be on the borderline of deficiency for a considerable period before this. The phosphorus content of the forage collected from the check plots, which consisted of native grasses, was considerably below the minimum requirements for beef cattle for all seasons.

On the basis of a minimum requirement of 0.13 per cent phosphorus in the forage (9, 34), it is apparent from the data in Table 7 that the phosphorus content in the forage during April and June from the fertilized plots is equal to or well above the minimum requirements for beef cattle, but not in September.

If the minimum phosphorus requirement of 0.18 per cent recommended by Guilbert, Gerlaugh, and Madsen (18) is used as a standard, the forage from all plots receiving less than 60 pounds of available P_2O_5 per acre annually is deficient in phosphorus for all seasons. It is apparent from the data that the phosphorus content in the forage from all fertilized plots will be nearing the critical levels before the end of the summer season.

The calcium content of the forage from all treatments (Tables 5, 6, and 7) was generally higher in the spring than in the summer or fall. However, the calcium content of the forage was relatively high throughout the growing season. Morrison (29) states that when legume hay or mixed hay containing considerable legumes forms any important part of the ration for cattle, sheep, or horses, they will ordinarily have an abundance of calcium. Even when no legume roughage is fed to these classes of livestock, there will usually be no deficiency of calcium unless the roughage is grown on soil very low in calcium.

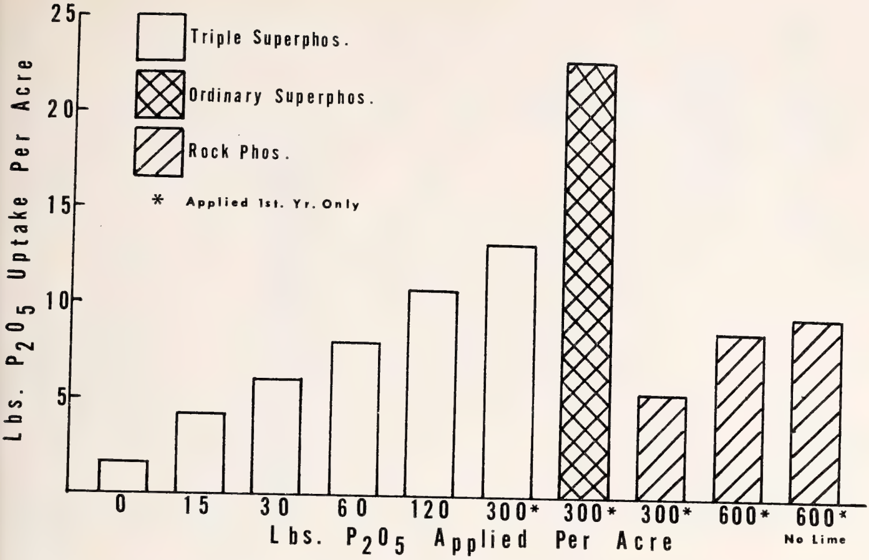


FIGURE 7.—The effects of the use of different sources and amounts of phosphorus on the P_2O_5 taken up by a mixture of rye grass, Louisiana S-1 white clover, and Dallis grass, 1953.

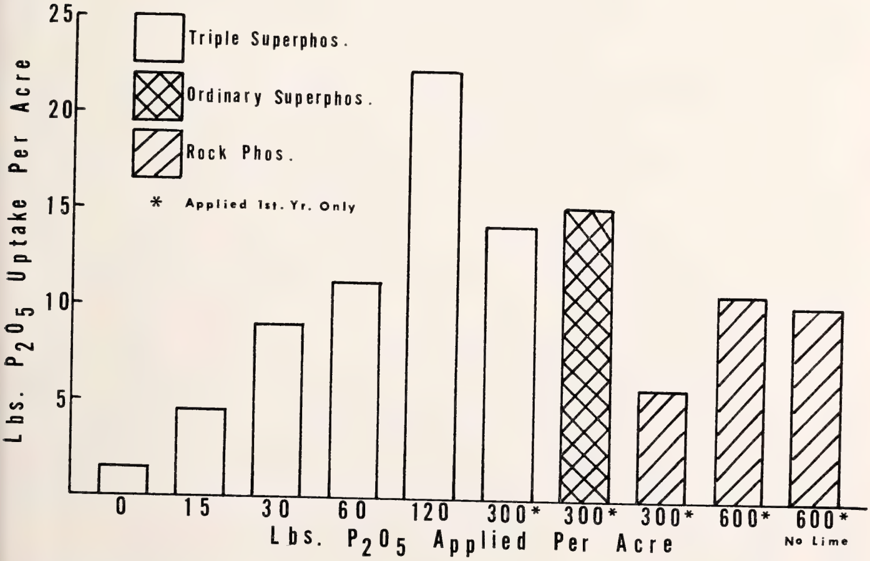


FIGURE 8.—The effects of the use of different sources and amounts of phosphorus on the P_2O_5 taken up by a mixture of rye grass, Louisiana S-1 white clover, and Dallis grass, 1955.

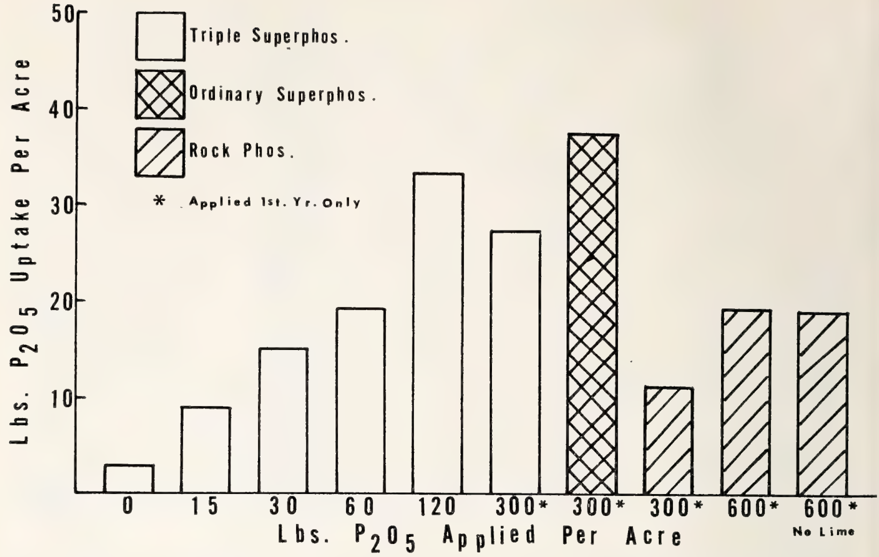


FIGURE 9.—The effects of the use of different sources and amounts of phosphorus on P_2O_5 taken up by a mixture of rye grass, Louisiana S-1 white clover, and Dallis grass, 1953 and 1955.

Most successful stockmen have at least a fair proportion of legume forage mixed with the total roughage available and are in that way supplying liberal amounts of calcium as naturally contained in the rations.

Examination of the data in Tables 5, 6, and 7 shows that the calcium content of forage from treatments receiving no lime was almost as high as in those treatments receiving lime. The data indicate that the native grasses growing on Bowie very fine sandy loam soil are relatively high in calcium, even though they are growing on soil of low calcium content and with pH 5.8. The application of lime to this soil is necessary to bring about proper soil reaction for the growth of white clover and grasses.

It is evident from these data that a phosphorus deficiency is more likely to occur than is a calcium deficiency.

It is known that calcium and phosphorus have definite relationships in animal nutrition. Calcium-phosphorus ratios in the ration as a whole have been found to be of importance. For the larger farm animals, suitable ratios vary from about 1 to 2.1 parts of calcium to each part of phosphorus. Ruminants have a greater tolerance for severly unbalanced calcium-phosphorus ratios, especially high calcium intakes, than have swine (29). While the desirable calcium-phosphorus ratio has been defined as one lying between 2:1 and 1:2, adequate nutrition is possible outside these limits. The optimum ratio varies somewhat according to the levels of these elements. With plenty of vitamin D in the ration, the ratio becomes less important, and more efficient utilization is made of the amounts of the elements present (25). For example, rations having a calcium-phosphorus ratio as wide as 6.5:1 have been entirely satisfactory for raising dairy calves (29). Considering the ratios reported by Morrison and Maynard as ideal, it will be seen that the ratios obtained in this experiment are relatively wide. However, the ratios fall within the range of satisfactory limits.

The data in Tables 5, 6, and 7 show that the calcium-phosphorus ratios varied with treatment, botanical composition, and season. The mean calcium-phosphorus ratios for 1953 and 1955 were 4.47:1 and 5.45:1 respectively. The data show that wider calcium-phosphorus ratios were obtained when the forage consisted largely of grasses. This result appears to be due to a high calcium content associated with a low phosphorus content in the grasses and not to a greater prevalence of clover.

The mean percentage of calcium was about the same for the different fertilizer treatments, while the mean percentage of phosphorus increased as the rate of phosphorus application increased. This difference in the percentage of phosphorus is reflected in the narrow calcium-phosphorus ratios for the plots receiving the higher rates of phosphorus.

A highly significant positive correlation was found between yield and the amount of available P_2O_5 applied per acre in 4 of the 6 correlation values determined. Other correlations between the contents of the different mineral elements in the plant material were inconsistent.

Summary and Conclusions

A study has been made of the effects of three sources of phosphorus, applied at different rates and times, on the yield, chemical composition, and nutritive value of a mixture of rye grass, Louisiana S-1 white clover, and Dallis grass grown under field conditions.

Significant differences in the dry matter production were obtained among the different phosphate treatments.

The highest total yield of dry matter for two years (1953 and 1955) was 8,783 pounds per acre from the superphosphate series. This yield was obtained from the initial application of 300 pounds of P_2O_5 per acre applied in the fall of 1952.

The highest total yield of dry matter from the rock phosphate treatments was 6,246 pounds per acre. This yield was obtained from the initial application of 600 pounds of P_2O_5 per acre.

Rock phosphate applied at the rate of 600 pounds of P_2O_5 per acre appears to be comparable to triple superphosphate applied at the rate of 300 pounds of P_2O_5 per acre for forage production.

The annual application of 60 pounds of P_2O_5 per acre from triple superphosphate was not sufficient to maintain yields of forage under meadow conditions.

The crude protein content of the forage from all fertilized plots was above the minimum animal requirements in the spring and early summer. The growth, largely grasses, in September did not contain enough crude protein to meet the nutritive requirements of beef cattle.

The calcium, phosphorus, magnesium, and potassium contents of the forage decreased with the advance of growing. The magnesium content of the forage varied less with season than did the other mineral elements.

In all instances the addition of phosphorus to the soil increased the phosphorus content of the forage. Only small increases in the phosphorus content of the forage were observed from additions above the 120 pounds of P_2O_5 level in 1953.

A comparison of triple superphosphate and ordinary superphosphate at the 300 pounds of P_2O_5 level shows that both sources supply phosphorus to the plants in approximately equal amounts. The residual effects from these two sources at this level appear to be equal at the end of the third year.

Phosphorus uptake was slightly greater from rock phosphate when no lime was applied. The percentage of phosphorus in the forage from the initial application of 600 pounds of P_2O_5 per acre from rock phosphate with no lime was approximately the same as that from 60 pounds of P_2O_5 per acre from triple superphosphate applied annually.

On the basis of an animal requirement of 0.13 per cent phosphorus in forage, the forage harvested from all fertilized treatments was equal to or above the minimum requirements for beef cattle in April and June, but the harvested forage was deficient in phosphorus from all treatments by September. On the basis of an 0.18 per cent phosphorus requirement in forage, the forage from the plots receiving less than 60 pounds per acre of available P_2O_5 was deficient in phosphorus throughout the season.

The calcium content of the forage, 0.30 per cent or more, appeared adequate from both limed and unlimed plots. Apparently a phosphorus deficiency is more apt to occur than is a calcium deficiency in the forage grown on this soil.

The calcium-phosphorus ratios were considerably wider than the optimum ratio of 2:1, but the ratios obtained fall within the range of tolerable limits.

A significant positive correlation was found between yield and the amount of available P_2O_5 applied per acre. Other correlations between the contents of the different mineral elements in the plant material were inconsistent.

Literature Cited

1. Alway, F. J., and Nesom, G. H. Influence of phosphorus deficiency of the soil on the protein content of alfalfa. J. Amer. Soc. Agron. 37: 555-569. 1945.
2. Anthony, J. L. The response of crops to applied phosphate on some Mississippi soils. Proc. Assoc. Agr. Workers. p. 47. 1952.
3. Archibald, J. H., and Bennett, E. Chemical composition of herbage from Massachusetts pastures. Mass. Agr. Exp. Sta. Bul. 300: 2-7. 1933.
4. Armstrong, S. F. The botanical and chemical composition of the herbage of pastures and meadows. J. Agr. Sci. 2: 283-304. 1908.
5. Association of Official Agricultural Chemists. Official methods of analysis. Washington, D.C. Ed. 7. 910 pp. 1950.
6. Beeson, K. C. The mineral composition of crops with particular reference to the soils in which they are grown. U.S. Dept. Agr. Misc. Pub. 369. 1941.
7. ————————. The occurrence of mineral nutritional diseases of plants and animals in the United States. Soil Sci. 60: 9-13. 1945.
8. Beeson, W. M., Bolin, D. W., Hickman, C. W., and Johnson, R. F. The phosphorus requirement for growing and fattening beef steers. Idaho Agr. Exp. Sta. Bul. 240: 1-14. 1941.
9. Black, W. H., Tash, L. H., Jones, J. M., and Kleberg, R. J., Jr. Effects of phosphorus supplement on cattle grazing on range deficient in this mineral. U.S. Dept. Agr. Tech. Bul. 856. 23 pp. 1943.
10. Cheaney, R. L., Weihing, R. M., and Ford, R. N. The effects of various rates and frequencies of application of rock and superphosphate on the yield and composition of forage on a Lake Charles clay loam soil. Soil Sci. Soc. Amer. Proc. 20: 66-68. 1956.
11. Crampton, E. W. Pasture studies IV. Nutritive value of pasture herbage: Quality of protein. Empire J. Exp. Agr. 2: 337-348. 1934.
12. Crampton, E. W., and Findlayson, D. A. Pasture studies VII. The effects of fertilization on the nutritive value of pasture grasses. Empire J. Exp. Agr. 3: 331-345. 1935.
13. Daniel, H. A., and Harper, H. J. The relation between total calcium and phosphorus in mature prairie grass and available plant food in the soil. J. Amer. Soc. Agron. 26: 986-992. 1934.
14. Davis, G. K. Trace elements in nutrition of cattle. J. Amer. Vet. Assoc. 119: 450-452. 1951.
15. DeTurk, E. E. The problem of phosphate fertilizers. Ill. Agr. Exp. Sta. Bul. 484: 543-583. 1942.
16. Dickman, S. R., and Bray, R. H. Colorimetric determination of phosphate. Industrial and Engineering Chemistry 12: 665-668. 1940.
17. Fraps, G. S., and Fudge, J. F. Phosphoric acid, lime and protein in forage grasses of the East Texas timber country. Soil Sci. Soc. Amer. Proc. 2: 347-351. 1940.
18. Guilbert, H. R., Gerlaugh, P., and Madsen, L. L. Recommended nutrient allowances for beef cattle. Natl. Res. Council. Washington, D.C. 32 pp. 1945.
19. Hart, G. H., and Guilbert, H. R. Factors influencing percentage of calf crop in range herds. Calif. Agr. Exp. Sta. Bul. 458. 43 pp. 1928.

20. Henderson, H. O., and Weakley, C. E., Jr. The effects of feeding different amounts of calcium and phosphorus upon the growth and development of dairy animals. W. Va. Agr. Exp. Sta. Bul. 231. 55 pp. 1930.

21. Larson, W. E., Nelson, L. B., and Hunter, A. S. The effects of phosphorus fertilization upon the yield and composition of oats and alfalfa grown on phosphorus deficient Iowa soils. J. Amer. Soc. Agron. 44: 357-361. 1952.

22. Long, O. H. "Rock phosphate or superphosphate?" Tenn. Agr. Exp. Sta. Farm and Home Sci. Prog. Rept. 16: 4. 1955.

23. Lyon, T. L. A test of floats as fertilizer and a study of the influence of farm manure on their effectiveness. New York Agr. Exp. Sta. Bul. 574. 31 pp. 1933.

24. Maynard, L. A. Interpretation of variations in plant composition in relation to feeding value. J. Amer. Soc. Agron. 29: 504-511. 1937.

25. ————————, and Loosli, J. K. *Animal Nutrition,* 4 ed. 484 pp. McGraw-Hill Publishing Co., New York. 1956.

26. McLean, E. O., Brown, D. A., and Hawkins, C. A. Comparative evaluation studies on rock and superphosphate. Ark. Agr. Exp. Sta. Bul. 528: 1-29. 1952.

27. Mitchell, H. H. Mineral requirements of farm animals. J. Animal Sci. 7: 365-377. 1947.

28. Moores, C. A. The comparative values of different phosphates. Tenn. Agr. Exp. Sta. Bul. 141. 18 pp. 1929.

29. Morrison, F. B. *Feeds and Feeding.* 20 ed. 1,050 pp. The Morrison Publishing Co., Ithaca, N.Y. 1936.

30. Murdock, J. T., and Seay, W. A. The availability to greenhouse crops of rock phosphate phosphorus and calcium in superphosphate-rock phosphate mixtures. Soil Sci. Soc. Amer. Proc. 19: 199-203. 1955.

31. Neller, J. R., and Lundy, H. W. Availability of residual phosphorus of superphosphate and rock phosphate determined by phosphorus in crops from radioactive superphosphate. Soil Sci. 74: 409-415. 1952.

32. Orr, J. B. *Minerals in Pasture.* 1 ed. 150 pp. H. K. Lewis and Co., Ltd., London. 1929.

33. Rich, C. I., and Lutz, J. A., Crop response to phosphate fertilizers in Virginia. Va. Agr. Exp. Sta. Tech. Bul. 115. 14 pp. 1950.

34. Savage, D. A., and Heller, V. G. Nutritional qualities of range forage plants in relation to grazing with beef cattle on the Southern Plains experimental range. U.S. Dept. Agr. Tech. Bul. 943. 61 pp. 1947.

35. Singleton, H. P., Nelson, C. E., and Stanberry, C. O. Fertilizers for irrigated alfalfa. Wash. Agr. Exp. Sta. Bul. 465. 29 pp. 1945.

36. Snedecor, G. W. *Statistical Methods of Analysis.* pp. 214-317. Iowa State College Press. Ames, Iowa. 1946.

37. Thorn, C. E. Raw phosphate rock as a fertilizer. Ohio Agr. Exp. Sta. Bul. 305: 227-277. 1916.

38. Toth, S. J., Prince, A. L., Wallace, A., and Mikkelson, D. S. Rapid quantitative determination of eight mineral elements in plant tis-

sue by a systematic procedure involving a flame photometer. Soil Sci. 66: 459-466. 1948.

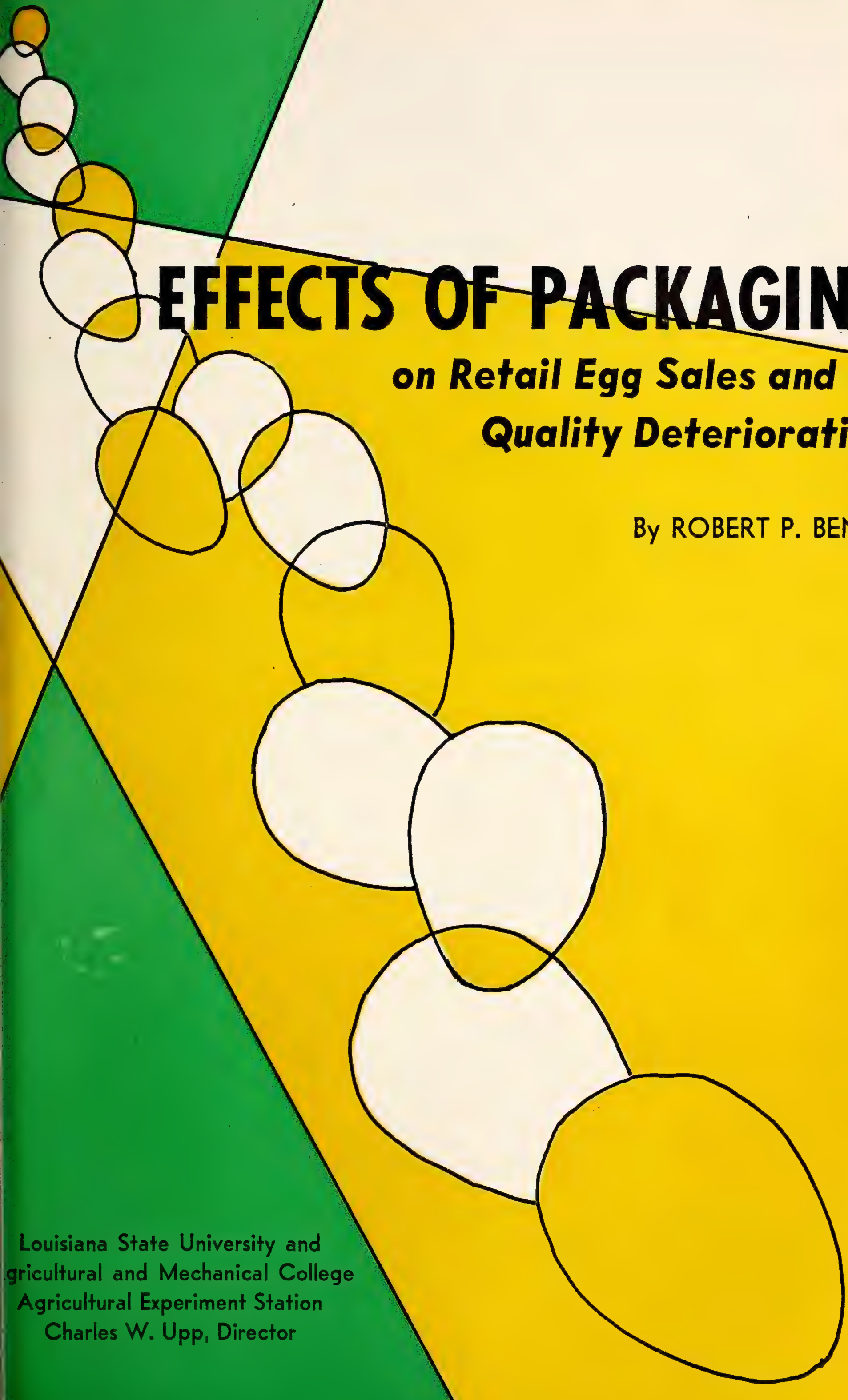
39. Vinal, H. N., Wilkins, H. L. The effects of fertilizer application on the composition of pasture grasses. J. Amer. Soc. Agron. 28: 562-569. 1936.

40. Volk, G. W. Availability of rock and other phosphate fertilizers as influenced by lime and forms of nitrogen fertilizers. J. Amer. Soc. Agron. 36: 46-56. 1944.

41. Watkins, W. E. The calcium and phosphorus contents of important New Mexico range forages. N. Mex. Agr. Exp. Sta. Bul. 246. 75 pp. 1937.

42. Woodhouse, W. W., Jr. Comparison of rock phosphate and superphosphate on crop yields. A summary of data. N. Carolina Agr. Exp. Sta. Circ. 148. 1949.

ETIN NO. 540 MAY, 1961



EFFECTS OF PACKAGING

on Retail Egg Sales and on Quality Deterioration

By ROBERT P. BENTZ

Louisiana State University and
gricultural and Mechanical College
Agricultural Experiment Station
Charles W. Upp, Director

Contents

Page

Introduction 3
  The Problem 3
  Objectives 4

Procedure 5
  Sales Response Test 5
  Quality Deterioration Study 9

Analysis of Findings 11
  Consumer Preference for Carton Type 11
  Consumer Acceptance of Egg Cartons 14
  Product Differentiation 16
  Interior Egg Quality 16

Summary and Conclusions 17

Acknowledgments

Appreciation is extended to the Lone Star Feed Company at Shreveport, Louisiana, for the special egg packaging required in the experiment. The assistance and cooperation of store managers and other personnel of the Kroger Foods Company is also gratefully acknowledged.

Effects of Packaging on Retail Egg Sales and on Quality Deterioration

Robert P. Bentz[1]

Introduction

The table egg industry in the United States supplies the consuming public with a product valued at nearly two billion dollars annually. The industry accounted for more than five percent of the cash farm income received by farmers in 1958. Total annual egg production has remained relatively constant, ranging over the last five years from a low of 168 million cases in 1957 to 173 million cases in 1959. Egg production for 1960 is estimated at 164 million cases, a decline of about five percent from 1959.

Louisiana's table egg industry accounted for 10 million dollars of cash farm income in 1958, the latest year for which complete data are available. Total cash farm income in Louisiana was approximately 362 million dollars in that year. Thus, the Louisiana egg industry accounted for only three percent of cash farm income, slightly below the national average. Nevertheless, eggs were the eighth most important agricultural commodity in the state in 1958, when ranked according to cash farm income. The importance of eggs has been slowly increasing in the last decade. As the population of the state increases, the importance of eggs to Louisiana agriculture also appears to be increasing.

The population of the United States increased about six percent from 1956 to 1960. During the same period egg production was relatively constant. Population forecasts indicate even greater growth for the future. Thus, while population has been increasing, per capita consumption of table eggs has declined (Table 1). This reflects a widespread change in consumer buying and eating habits over the years.

The Problem

One of the most important problems facing the egg industry is the decline in per capita egg consumption. A second problem is maintaining quality until the egg is purchased by consumers.

Egg producers are unable to do much about the price of eggs because of the nature of the market structure. Individual producers are able to sell all of their eggs at the going market price but are unable to cause increases in the market price of eggs by individually restricting their output.

---

[1] Assistant Specialist, Agricultural Extension Service, Louisiana State University; formerly Instructor, Department of Agricultural Economics at L.S.U. The author is indebted to Dr. E. P. Roy and Dr. F. H. Wiegmann for their critical review of the manuscript.

TABLE 1.—Per Capita Consumption of Shell Eggs, United States, 1951 - 1960

Year	Total Eggs Consumed Per Capita[1]	Year	Total Eggs Consumed Per Capita[1]
1951	365	1956	343
1952	362	1957	331
1953	354	1958	323
1954	351	1959	313
1955	346	1960[2]	304

[1] Total excludes frozen and dried egg products.

[2] Total for 1960 is estimated from data for five months.

Source: Agricultural Marketing Service, *The Poultry and Egg Situation*, Washington, D.C.: United States Department of Agriculture.

Like other farmers, egg producers have been caught in a cost-price squeeze. To lower the retail price of eggs as a means of encouraging consumption would only result in reduced income to the farmer, because of the relatively inelastic demand for eggs. In other words, there would be a less than proportionate increase in net revenue resulting from a given reduction in price. In recent years, however, producers have increased the size of their operation (volume) in order to gain efficiency and reduce per unit costs. This has helped to some extent. But for this approach to have continued success, there must be a shift in the demand for eggs such that more eggs will be consumed at any given price.

With respect to maintaining quality, there have been great improvements in "bred-in" egg quality. Likewise, "quality retaining" practices have been widely adopted by handlers of eggs in the marketing channel. Still, like most other food products, eggs will decline in quality over time. A major problem in marketing eggs is to control the amount of this deterioration.

Objectives

The primary objective of this study was to determine if certain merchandising practices, for example, the use of certain carton combinations at various price differentials, would increase table egg sales and thus egg consumption. More specifically, the objectives were to (1) determine consumer preference for cellophane-overwrapped containers displayed with standard 2 x 6 cartons, (2) determine consumer preference for the clear plastic carton relative to the standard and overwrapped cartons when an added markup was charged for the plastic container and (3) determine the effect on total egg sales when clear plastic cartons were displayed with standard or overwrapped cartons and when the plastic carton was offered at various differentials.

A secondary objective was to determine the quality retaining characteristics of several packaging techniques. These techniques included the cellophane-overwrapped carton, mineral oil spray and a control or untreated lot for comparison purposes.

Procedure

Sales Response Test

The study of merchandising practices was conducted in the late spring of 1960 in Shreveport, Louisiana. Since sales promotion programs, special holidays and periods of unusual sales fluctuation should be avoided in an experiment of this kind, the sales response test was held during this period of relatively constant sales.

The cartons sold during the experiment were: (1) Standard 2 x 6 paperboard carton (*A*, Figure 1). (2) Standard 2 x 6 carton overwrapped with cellophane (*B*, Figure 1). (3) Plastic 2 x 6 carton clear on top with a blue styrene plastic bottom (*C*, Figure 1).

U. S. Grade A large white eggs were packed in all three cartons. Cartons (1) and (2) were alike in every respect with the exception of the cellophane overwrap. The clear plastic carton had the same brand identification as the standard and the overwrapped cartons but differed in that consumers were able to visually inspect the eggs before purchase.

It was not considered likely that any of the cartons would alone cause great increases in sales volume. Therefore, various combinations of the cartons were tested to determine which combination would result in increased sales.

Since the plastic carton is a more expensive carton to produce than the others, a price differential of four cents, approximating this difference, was selected as a base. This assumes that the main benefit of this carton, i.e., the clear top, is mainly for the consumer. Consequently, it should be paid for by the consumer and not be absorbed in the marketing margin. An even higher price differential of seven cents was also used to determine if consumers would react differently to the plastic container priced at a premium. The following five combinations of packages (dual displays) were used:

(1) Standard 2 x 6 carton and the same carton overwrapped with cellophane (no price differential).
(2) Standard 2 x 6 carton and clear plastic carton with an added four-cent markup.
(3) Standard 2 x 6 carton and clear plastic carton with an added seven-cent markup.
(4) Standard 2 x 6 carton overwrapped with cellophane and clear plastic carton with an added four-cent markup.
(5) Standard 2 x 6 carton overwrapped with cellophane and clear plastic carton with an added seven-cent markup.

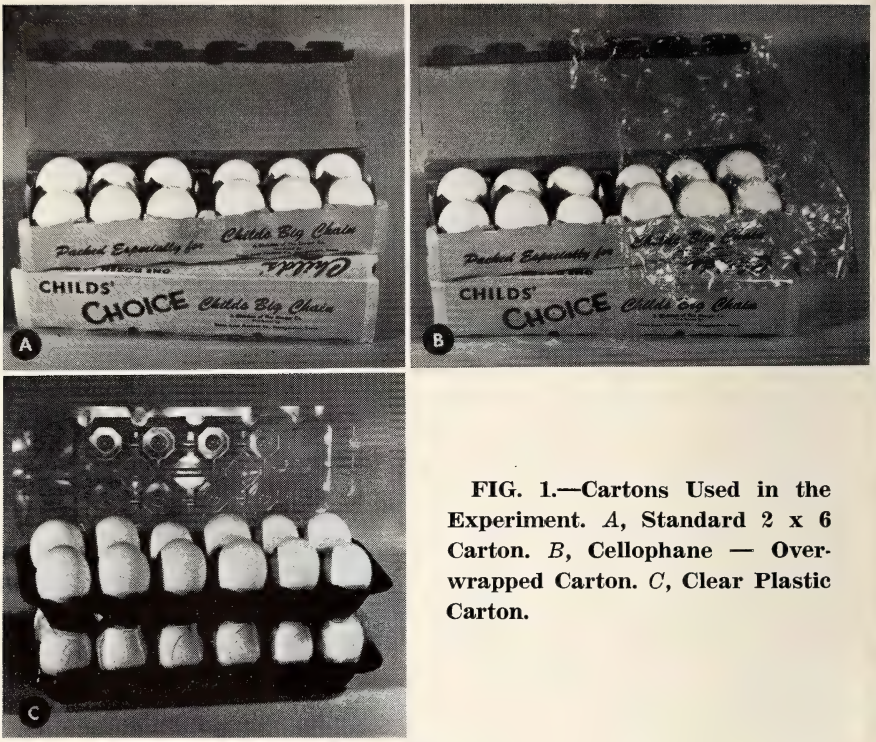


FIG. 1.—Cartons Used in the Experiment. *A*, Standard 2 x 6 Carton. *B*, Cellophane — Over-wrapped Carton. *C*, Clear Plastic Carton.

The experiment ran for five weeks in five stores. The dual displays were placed in each store for a one-week period and then rotated to the next store. Thus, after five weeks each display had been in every store. Since most customers purchase groceries at least once a week, the response to a given combination of packages represents essentially the reaction of each store's usual clientele.

The five stores chosen were widely dispersed about the city of Shreveport. All were located in shopping centers having adequate parking facilities. Some were located in low income sections of the city and others in high income areas. Although no survey was taken to determine the exact characteristics of each store's clientele, the study included a wide range in types of customers.

The display cases were refrigerated in all five supermarkets. Four of the five stores had horizontal open-top cases, commonly referred to as dairy cases (Figure 2). The fifth store had a vertical enclosed display. Other food items, such as milk and butter, were displayed along with eggs in all five stores.

The size of the experimental displays was determined by the amount of space allotted to Grade A large eggs in each store. This space was divided *equally* between the two types of cartons to be

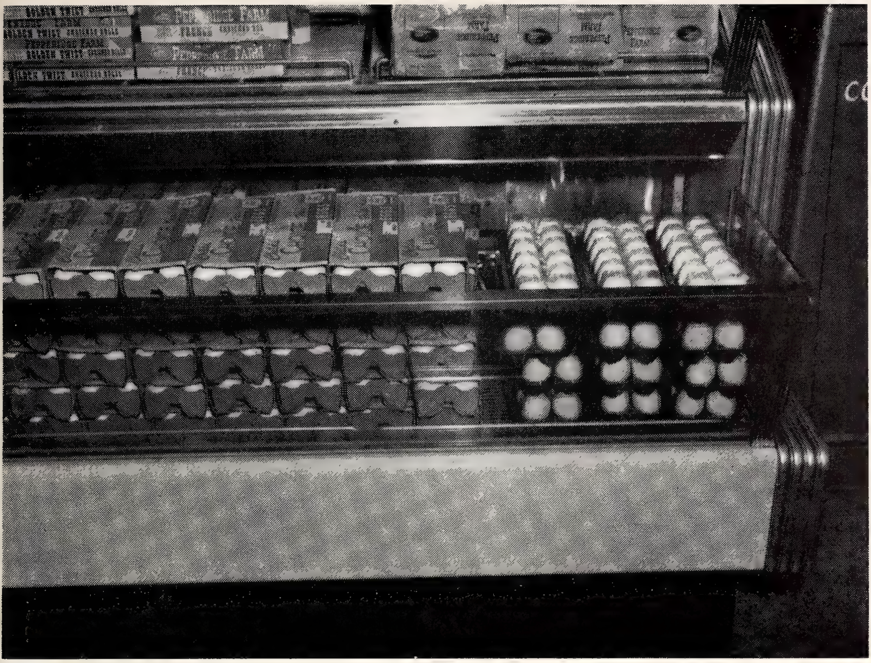


FIG. 2.—Example of a Typical Display Case in One of the Stores Used for the Experiment.

displayed. The position of the entire display remained unchanged for the duration of the experiment. Volume of eggs displayed in each store varied from 120 to 192 dozen per display at full capacity.

Conducting the Test—Regular invoice numbers were assigned to each experimental carton for purposes of ordering. Store personnel who normally ordered the eggs were supplied with lists showing which types of cartons were to be sold during each time period. The quantity to be ordered was left to the discretion of store personnel. When eggs in a given store were left over from a previous week and were packed in a carton not scheduled to be in that store the following week, arrangements were made to shift these eggs to another store.

Each store was visited three times daily by a research field worker. If either or both sides of the matched display were low, they were restocked. Between visits of the field worker, regular store employees stocked the egg displays when necessary.

The displays were allowed to naturally decrease in size and were not kept full all of the time. However, the decrease in size was allowed to occur only through a lessening of the height of the displays. The number of linear feet of display space facing customers was held constant throughout the experiment. Furthermore, the height of the two parts of each display was continually adjusted to keep both sides approximately matched in appearance. The normal practice was to fill the display case to capacity on the first day of each time period. Thereafter, the display was restocked as necessary to maintain an attractive display, matched in appearance and having at least a little "built-in action."

Each time period was begun on a Tuesday morning and ended at the close of business the following Monday. Since it is a common practice in supermarkets to restock depleted displays during the earlier part of the week, this practice was also followed by the researcher. Every Tuesday morning an accurate count of all eggs in the display case and backroom storage was made. This inventory served as the ending inventory for one time period and the beginning inventory for the next.

To determine the number of dozens sold of each category of eggs, the ending inventory was subtracted from the beginning inventory with an adjustment for eggs delivered during the week. No adjustments in sales were made for cartons which contained broken eggs and which may not actually have been sold, since there was no accurate method to determine the number of dozens so rejected.

The matched-lot experimental design in marketing research is subject to a non-test variable called the "position effect." Customers are known to follow a somewhat consistent route through the various parts of most supermarkets. When there is more than one display of a given commodity, there is a strong tendency for customers to select the item to be purchased from the first display passed. To remove this position effect, the order of the displays was reversed twice each week.

Pricing of Eggs—It was important to allow prices to fluctuate in a normal fashion so that the stores in the experiment could remain competitive with stores not taking part. It was not the intent of the experimenters to attract customers who normally shopped elsewhere, and it is acknowledged that price is in itself a causal force in determining what consumers will buy. Prices, therefore, were set in accordance with the grocery chain's normal procedure, with the exception of the additional markup assigned to the clear plastic containers. Prices were the same in all five stores.

During the first week a price of 52 cents was charged for the Grade A large eggs in the experimental cartons. The second week, the price was 49 cents, and the third week it was lowered to 47 cents. The last two weeks of the experiment the price was 49 cents. The price adjustments made from week to week of only two to three cents probably did not greatly affect egg sales.

It should be remembered that in every comparison of sales from dual displays involving the plastic carton, the effect of price was inseparable from the measurement of consumer preference. However, measuring the relative preferences for the cartons at equal prices would be of little value, since the plastic carton is more expensive to produce than the other and would not normally be sold at the same price.

Quality Deterioration Study

A logical adjunct to the merchandising experiment was the determination of the quality maintenance characteristics of the various cartons for which sales response had been determined. Consequently, a controlled experiment was used to determine the rate of decline in quality due to various packaging factors. The experiment was begun on July 8, 1960, and concluded on July 29, 1960.

Cold storage and mineral oil are used for maintaining egg quality for relatively long holding periods in the industry today. Most eggs, though, are not held in storage but are moved rapidly through the marketing channel to the consumer. Still, some decline in quality does occur in fresh eggs, and it is this decline with which we are concerned. The magnitude of decrease in quality is about two-thirds of a grade, or approximately 15 Haugh units.[2] This measure of quality decline was determined in previous experiments for eggs sold in retail outlets and fresh eggs laid under typical Louisiana temperature and humidity conditions.

It is a generally accepted fact that egg quality declines over time. Varying temperature and humidity conditions also greatly affect the amount of this deterioration in quality. An experiment was conducted to determine which of several factors were responsible for quality decline and which, if any, of several treatments slowed down quality loss. The factors included in the design of the experiment were two temperature conditions, three merchandising practices and four time periods. The design called for 864 individual measurements of egg quality.

Conducting the Test—The basic time period was a seven-day interval. A sample of 216 eggs was measured when the eggs were one day old and once each seven days thereafter for three weeks. The experiment was concluded at the end of three weeks because this closely approximates the maximum length of time that eggs are in the marketing channel.

Eggs were held under two temperature conditions—room temperature and refrigerated storage. Room temperature was maintained relatively constant at 73 degrees Fahrenheit with the aid of air conditioning. Under the second temperature condition, refrigerated storage, temperature was held at approximately 45 degrees Fahrenheit. One-half of the sample, or 432 eggs, was held under each of the temperature conditions.

---

[2] Haugh unit: A measure of internal egg quality based on the height of thick albumen adjusted by the weight of the egg.

Three merchandising practices were also tested for their effect on egg quality as follows:

(1) Untreated eggs placed in standard 2 x 6 paperboard cartons.
(2) Untreated eggs in standard cartons overwrapped with cellophane.
(3) Eggs sprayed with a light neutral mineral oil and packed in standard cartons.

Eggs used for the experiment were collected from two of the cage houses at the Louisiana State University Poultry Farm in Baton Rouge. All birds had been fed a similar ration and had been uniformly handled throughout the year. The hens were all of a single commercial Leghorn strain and had been in production for approximately 10 months. All eggs were infertile.

Eggs with cracked shells, blood and meat spots and those below U.S. Grade A large were removed. The remaining eggs, a total of 72 dozen, all from one day's lay, were then placed in standard 2 x 6 cartons. Twenty-four of these dozens were packed in cartons and left untreated. A similar number were overwrapped with cellophane, and the remaining 24 dozen were treated with a light mineral oil.

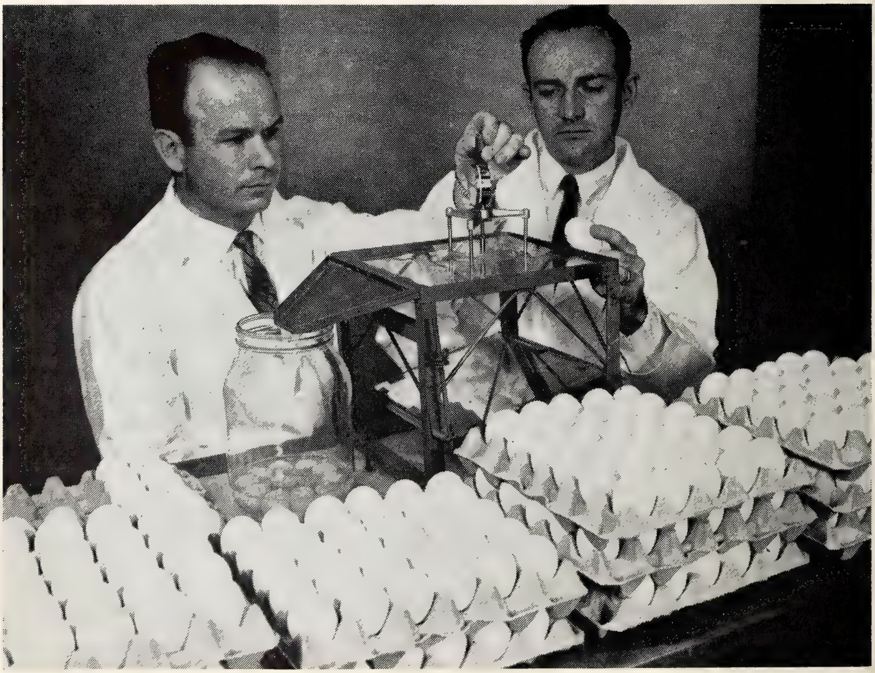


FIG. 3—Illustration of the Egg Measurement Process.

Measurement of Egg Quality—Eggs were first weighed individually and then broken out onto a flat glass surface. The height of thick albumen was measured with a micrometer and recorded in milimeters, along with the egg's weight in ounces (Figure 3). These values were later converted to a single measurement termed Haugh units.

Analysis of Findings

Consumer Preference for Carton Type

Standard Versus Cellophane-Overwrapped Cartons—A preference was shown for the cellophane-overwrapped carton when compared to the standard carton. The preference, though, was not nearly so strong as was demonstrated in the comparisons yet to be discussed. In fact, in one store the standard carton was preferred over its overwrapped counterpart, and in another, sales were approximately equal. In the remaining three stores, the cellophane-wrapped carton was preferred over the standard container; in one instance, by as much as two to one (Table 2).

An analysis of the total egg sales for all stores together indicated that, in total, the cellophane-wrapped package was preferred over the standard.

Store III, the store in which the preference for the standard carton was indicated, was the one store which had a vertical glass-enclosed display case. It is possible that the glass windows may have reduced the light reflecting quality of the cellophane wrapping. This might account for the lack of consumer response to the cellophane wrap in this store.

TABLE 2.—Sale of Eggs in Standard Cartons Versus Cellophane-Overwrapped Cartons, Five Supermarkets, Shreveport, Louisiana, April 26, 1960, Through June 7, 1960

Store Number	Total Sales	Standard Sales	Cellophane Sales	Percent Standard Was of Total
		Number of Dozens		
I	1,185	489	696	41.2
II	903	444	459	49.2
III	933	524	409	56.3
IV	1,005	402	603	40.0
V	663	241	422	36.3
Total	4,689	2,100	2,589	44.8

It would seem, nevertheless, that the manner in which eggs are displayed is not all that is involved. In certain stores there was a marked preference for cellophane-wrapped cartons. In others this was not the case. Consequently, the problem of identifying the characteristics of stores and their customers which cause one carton to be preferred over the other should be seriously considered. The practice of overwrapping might be limited to the stores where it added most to consumer satisfaction. It should be noted that this comparison (standard versus cellophane-wrapped cartons) was the only one tested which did *not* involve a price differential. The preference shown can be considered to be entirely due to the type of container.

Standard Versus Plastic with an Added Four-Cent Markup—In the second matched-lot comparison (standard versus the plastic carton with an added four-cent markup) the preference for the standard carton was very definite. Only 11.8 percent of the total sales in the five stores were in plastic cartons (Table 3). The lack of preference for the plastic carton may have been due, however, to its premium price. It might also have been caused by the fact that this carton was relatively new in the supermarkets where it was tested (it had been on sale for only four months prior to the experiment). A third causal factor may have been the fragile appearance of the carton. No matter what the reason, standard cartons were definitely preferred by consumers over the clear plastic containers in this matched comparison.

TABLE 3.—Sale of Eggs in Standard Cartons Versus Plastic Cartons with an Added Four-Cent Markup on the Plastic Carton, Five Supermarkets, Shreveport, Louisiana, April 26, 1960, Through June 7, 1960

Store Number	Total Sales	Standard Sales	Plastic Sales	Percent Standard Was of Total
		Number of Dozens		
I	1,078	932	146	86.4
II	730	665	65	91.9
III	983	914	69	93.0
IV	880	739	141	84.0
V	628	544	84	86.6
Total	4,299	3,794	505	88.2

Standard Versus Plastic with an Added Seven-Cent Markup—In all of the sales comparisons, preference for one carton over the other was assumed to exist when the ratio of sales deviated significantly from one to one. In the third comparison, that of standard versus plastic cartons with an added *seven*-cent markup, there was again no question concerning which was preferred. As would be expected, sales of eggs in plastic cartons were small, ranging from only 6.6 to 20.9 percent of the total for the five stores (Table 4). The over-all average of plastic carton sales was 11.4 percent of the total sales. This was essentially the same proportion sold when the price differential between cartons was only four cents.

Cellophane Versus Plastic with an Added Four-Cent Markup—A similar comparison was made using a cellophane-overwrapped carton and the clear plastic container. This fourth matched-lot again involved a *four*-cent price differential on the plastic carton. Sales of eggs in plastic cartons ranged from 10.2 to 21.8 percent of total egg sales among the various stores (Table 5). The weighted average was 12.7 percent, again not greatly different from the previously discussed comparisons.

TABLE 4.—Sale of Eggs in Standard Cartons Versus Plastic Cartons with an Added Seven-Cent Markup, Five Supermarkets, Shreveport, Louisiana, April 26, 1960, Through June 7, 1960

Store Number	Total Sales	Standard Sales	Plastic Sales	Percent Standard Was of Total
		Number of Dozens		
I	900	841	59	93.4
II	570	451	119	79.1
III	1,247	1,140	107	91.4
IV	1,369	1,201	168	87.7
V	515	442	73	85.8
Total	4,601	4,075	526	88.6

TABLE 5.—Sale of Eggs in Cellophane-Overwrapped Cartons Versus Plastic Cartons with An Added Four-Cent Markup, Five Supermarkets, Shreveport, Louisiana, April 26, 1960, Through June 7, 1960

Store Number	Total Sales	Cellophane Sales	Plastic Sales	Percent Cellophane Was of Total
		Number of Dozens		
I	999	892	107	89.3
II	730	571	159	78.2
III	1,103	962	141	87.2
IV	1,310	1,175	135	89.7
V	751	674	77	89.7
Total	4,893	4,274	619	87.3

Cellophane Versus Plastic with an Added Seven-Cent Markup—In the fifth and last comparison, cellophane-wrapped cartons versus plastic cartons with an added *seven*-cent markup, a strong preference for the overwrapped carton (at the lower price) was again displayed. The proportion of dozens sold in plastic containers ranged from 9.0 to 15.7 percent of total sales (Table 6). The weighted average was 10.6 percent, only slightly less than the proportion of plastic cartons sold when the price differential was four cents.

Thus, standard cartons and the same cartons wrapped in cellophane were preferred over the higher priced, clear plastic cartons in all stores and at both price differentials. It was noted that there was essentially no difference in proportion of dozens sold in plastic cartons when the price differential was varied from four to seven cents above the standard carton. Furthermore, the cellophane-wrapped carton was preferred over its unwrapped counterpart at equal prices.

TABLE 6.—Sale of Eggs in Cellophane-Overwrapped Cartons Versus Plastic Cartons with An Added Seven-Cent Markup, Five Supermarkets, Shreveport, Louisiana, April 26, 1960, Through June 7, 1960

Store Number	Total Sales	Cellophane Sales	Plastic Sales	Percent Cellophane Was of Total
		Number of Dozens		
I	1,105	1,005	100	91.0
II	828	719	109	86.8
III	1,028	932	96	90.7
IV	1,170	986	184	84.3
V	960	908	52	94.6
Total	5,091	4,550	541	89.4

Consumer Acceptance of Egg Cartons

Although it is of more than passing interest to know what type egg cartons consumers prefer, of more importance to the egg industry is whether or not better merchandising will increase total sales. It has been shown that consumers prefer the standard or the cellophane-wrapped cartons over clear plastic cartons. However, it cannot be deduced from the findings discussed thus far that egg consumption would be increased if industry followed the preferences indicated and ceased to offer the plastic carton. In fact, were the plastic carton not used, it is quite possible that a drop in egg purchases would result. Some customers who had been buying the clear plastic carton might not shift to the standard but would go elsewhere for their eggs. The effect on volume of sales would depend on how strongly customers held to their preferences.

Are Total Sales Increased?—It is the purpose of this section of the report to bring to light whether or not egg consumption is increased as the result of any of the various merchandising practices tested. Since sale of eggs is considered synonymous with egg consumption, an increase in sales for a given combination of merchandising practices would indicate that this combination increased egg consumption.

To ascertain which, if any, combinations of egg cartons increased egg consumption, the two parts of each matched display were combined and the average of total sales for the display computed (Table 7). Sales were also converted to a per-100-customer basis to remove any bias due to number of customers.

It is evident from these data that the combination which sold the *least* number of dozens was the standard and clear plastic cartons with the four-cent price differential. This display had an average sale of 859.8 dozen per week, which amounts to 35.8 cases per week, in each of the five stores. It is of particular interest in that this was the combination of egg cartons and price differentials which was in use in the grocery chain just prior to the start of the experiment. This display resulted in the sale of 10.6 dozen (all five stores) per 100 customers.

The display which had the *greatest* volume of sales was the cellophane-wrapped carton and the plastic carton with the added seven-cent markup. The average for this display was 1,018.2 dozen per store, or 42.4 cases a week. Sales per 100 customers were 13.2 dozen, an increase of 2.6 dozen over the display with the lowest volume of sales. This difference in sales response was found to be greater than would be expected by chance variation.

Actually, any of the displays which included the higher price differential or the cellophane overwrap resulted in a significantly increased volume of sales. Average weekly volume of sales for the combination of standard and plastic cartons with an added four-cent markup was 859.8 compared to 963.7 dozen for the other four displays combined. Consequently, egg consumption was *increased* by the use of cellophane-wrapped and/or a higher price differential on the plastic carton when sold along with the familiar standard carton.

TABLE 7.—Average Number of Dozens of Eggs Sold for Various Combinations of Carton Types, Five Supermarkets, Shreveport, Louisiana, April 26, 1960, Through June 7, 1960

Combined Displays	Average Weekly Sales	Sales per 100 Customers
	Dozens	
Standard & Plastic at 4¢	859.8	10.6
Standard & Plastic at 7¢	920.2	11.8
Standard & Cellophane	937.8	12.0
Cellophane & Plastic at 4¢	978.6	12.6
Cellophane & Plastic at 7¢	1,018.2	13.2
Weighted Average	942.9	12.0

Product Differentiation

Essentially, what has been demonstrated is the effects of *product differentiation.* One of the goals of product differentiation is to encourage consumers to desire a given brand or kind of product rather than merely the product itself. Another goal is to increase sales by offering several items quite similar in nature but "differentiated." Differentiation is accomplished by the use of brand names, grading, advertising and even unique containers. Several alternatives are made available to consumers who can then choose the ones which offer the most "consumer" satisfaction.

Eggs are often differentiated in this way. In some instances, price differentials are involved which take advantage of the fact that different income groups have different tastes. The actual difference in quality and size of the eggs themselves is in some instances substantial. In others there may be less justification for the higher price of certain brands or different packaging. Nevertheless, if sales are increased by this product differentiation, it can be assumed that greater "consumer" satisfaction has been obtained, in addition to greater profit for the producer and those in the marketing channel.

Interior Egg Quality

Average quality of eggs broken-out at one day of age in the quality deterioration study was just slightly below U.S. Grade AA (Table 8). In light of the age of hens and the high humidity and temperature conditions in which the eggs were laid, this score was excellent.

TABLE 8.—Average Quality of Eggs by Temperature, Time Period and Treatment, Egg Quality Deterioration Experiment, Baton Rouge, Louisiana

Treatment by Temperature	One Day	One Week	Two Weeks	Three Weeks	Weighted Average
			Haugh Units[1]		
Room Temperature					
Standard Carton	77.1	52.9	39.9	20.4	47.6
Mineral Oil	77.0	64.8	64.3	51.6	64.4
Cellophane	77.5	60.5	50.8	28.6	54.4
Weighted Ave.	77.2	59.4	51.7	33.5	55.4
Refrigeration					
Standard Carton	78.8	74.9	73.5	73.1	75.1
Mineral Oil	78.3	78.4	71.6	73.4	75.4
Cellophane	78.0	77.2	70.7	64.8	72.7
Weighted Ave.	78.4	76.8	71.9	70.4	74.4
Over-all Weighted Average	77.8	68.1	61.8	52.0	63.7

[1] USDA Grade AA, 79 Haugh units and over; A, 55—78 Haugh units; B, 31—54 Haugh units; C, 30 Haugh units and below.

The fact that these day-old eggs were not AA in quality, however, emphasizes the virtual impossibility of marketing all eggs from the same flock as AA grade throughout the year in this section of the country. It means that only a given percentage of day-old eggs could and should be marketed as U.S. Grade AA.

Over the three-week period, average quality declined a total of 25.8 Haugh units, from 77.8 to 52.0 Haugh units, or from Grade A to Grade B. Eggs kept under refrigeration declined from 78.4 to 70.4 Haugh units, a drop of only 8 Haugh units, while eggs kept at room temperature declined 43.7 Haugh units in the same three-week period (from Grade A to Grade B).

For eggs kept under refrigeration, there was no difference in quality retention among the three groups (untreated, cellophane wrapped and mineral oil treated).

For eggs held at room temperature, those sprayed with mineral oil retained their quality better than either the untreated group or the eggs in cartons overwrapped with cellophane. There was essentially no difference in quality between the untreated group and the overwrapped eggs. Both of these samples declined from A to C grade in three weeks. Consequently, if eggs are to be held for any length of time at room temperature, the most effective way of maintaining their quality (of the methods tested) is with mineral oil. But if they are to be kept under refrigeration until consumed, it is difficult to justify oil treating or cellophane wrapping on the basis of quality retention.

Summary and Conclusions

Customers in three out of five stores showed a preference for cellophane-overwrapped egg cartons over standard cartons at equal prices. For all five stores combined, 55 percent of one week's sales were of cellophane-wrapped cartons, which indicates there was only a slight preference for cellophane-wrapped cartons.

The standard carton and the standard carton overwrapped were preferred over a clear plastic carton when the plastic carton was sold at a higher price of from four to seven cents. Only 12 per cent of weekly sales were in clear plastic cartons. Customers were either unwilling to pay the higher price or, in fact, did not prefer the plastic containers.

The dual display which resulted in the *greatest* sales volume was the cellophane-overwrapped carton and the clear plastic container with an added seven-cent markup. This display had sales amounting to 13.2 dozen per 100 customers.

The dual display which resulted in the *least* sales volume was the standard carton and the plastic carton with an added four-cent markup. This display resulted in sales of 10.6 dozen on a per-100-customer basis.

Total sales, and thus egg consumption, were increased by those display combinations involving cellophane-overwrapped cartons and plastic cartons at the two price differentials. Total sales were also increased over the usual volume by merely *increasing* the price differential on the plastic carton from four to seven cents in the displays with the familiar standard carton.

Egg quality decline was negligible (8.0 Haugh units) for eggs held at 45 degrees Fahrenheit for three weeks. Eggs kept at room temperature for the same length of time declined 43.7 Haugh units, or from Grade A to Grade B. Thus, the primary cause of quality decline in eggs was found to be high temperature.

Quality of eggs in cellophane-wrapped cartons kept at room temperature was not significantly different from that of untreated eggs in standard cartons kept under similar conditions. However, eggs treated with mineral oil were significantly higher in quality than either eggs in cellophane-wrapped cartons or standard cartons held at room temperature.

ARTIFICIAL INSEMINATION OF CATTLE

UNIVERSITY OF MARYLAND

OCT 16 1967

McK

T. E. Patrick, H. C. Kellgren
and Cecil Branton

LETIN NO. 541

MAY 1961

Louisiana State University and
Agricultural and Mechanical College
Agricultural Experiment Station
Charles W. Upp, Director

Table of Contents

Page

Introduction 3
  Advantages of Artificial Insemination 3
  Limitations of Artificial Insemination 4
  Historical Aspects 5
Structure and Functions of the Reproductive Organs 7
  Male Reproductive Organs 7
  Female Reproductive Organs 8
  Reproductive Events 12
Collecting, Evaluating, Processing and Shipping Bull Semen 12
  Collection of Semen 12
  Evaluation of Semen 14
  Cooling and Storing Semen 17
  Semen Extenders and Rate of Extension 18
    Egg Yolk-Citrate-Sulfanilamide Extender (Diluter) 20
      Citrate Sulfanilamide Buffer 20
      Egg Yolk 20
    Milk Extender 20
    The Use of Antibiotics in Semen 21
      Preparation of Antibiotic Solutions 21
    Rate of Extending Semen 22
  Shipping and Handling Semen Under Field Conditions 22
Processing, Storing and Using Frozen Semen 24
  Preparation of Extender and Freezing of Semen 25
    Preparation of Egg Yolk-Citrate-Glycerol Extender 25
    Extending, Cooling and Equilibration 25
  Storage of Frozen Semen 26
  Care and Use of Frozen Semen in the Field 29
  Suggestions and Precautions Regarding Frozen Semen 30
Insemination of the Cow and Determination of Pregnancy 31
  Methods of Insemination 31
    Vaginal Method 31
    Shallow Cervical (Speculum) Method 31
    Deep Cervical or Intra-Uterine Method 32
  Pregnancy Determination 35
Fertility of Cattle 37
  Measures of Fertility 37
  Factors Influencing Fertility 38
    Heredity 38
    Environment 39
      Time of Postpartum Service 39
      Time of Service During Heat Period 41
      Age of Cow 42
      Seasonal Effects 42
      Diseases 43
      Physiological Disorders 44
      Feeding and Management 45
Selecting Sires for Use in Artificial Insemination 46
  Proved Sires .... [illegible]
  Selected Young Sires .... [illegible]
  Health of Bulls .... [illegible]
Records and Reports Used in Artificial Insemination .... [illegible]
Summary of Important Facts Relating to Artificial Insemination .... [illegible]
References .... [illegible]

T. E. PATRICK, H. C. KELLGREN, AND CECIL BRANTON

Introduction

Artificial insemination is generally considered to be the greatest single tool available to the dairy farmer for making mass improvement in the heredity of his cattle. Few, if any, practices designed to increase milk production and improve the type of cattle have enjoyed the popularity and general acceptance on the part of dairymen as has artificial insemination. The annual average milk production is 6,438 pounds for all dairy cattle in the United States, and is only 3,892 for the South Central States, including Louisiana. Milk production levels for commercial dairy cattle are somewhat higher than those given above. In comparison, the production level for all artificially sired daughters which have been tested is 10,583 pounds of milk per year. Bulls of this caliber will do much to increase efficiency of production.

Advantages of Artificial Insemination

There is general agreement among the leaders in the livestock industry that artificial insemination has several distinct advantages over natural mating:

1. The usefulness of outstanding sires is increased manifold. A sire possessing the ability to transmit high production and desirable type can be used to breed several thousand cows in many different herds each year. In natural mating, his service would be limited to 50 or 60 cows in one or two herds.

2. Commercial dairymen and small breeders have the services of much better bulls than they could afford to buy. Many dairymen are still using grade bulls or inferior registered sires on which little or no information is available concerning the production or type of their ancestors and close relatives.

3. The danger of spreading genital disease, such as vibriosis, is greatly reduced. All bulls used in organized artificial breeding associations are tested for all known diseases before being placed in service and at regular intervals thereafter. As an added measure of protection, all semen used in the Louisiana program is treated with antibiotics that will destroy any disease producing bacteria that might be present.

ACKNOWLEDGMENT—The authors wish to acknowledge and express their appreciation to Lorraine Boss Allen for making the drawings and to Dr. J. E. Johnston for doing the photographic work for this publication. Appreciation is also expressed to Drs. J. B. Frye, Jr., and J. E. Johnston for their suggestions and criticisms of the manuscript.

4. Artificial insemination eliminates the trouble, danger, and expense of keeping a bull. The dairy bull is the most troublesome and dangerous animal on the farm. Many farm people are killed or seriously injured by bulls each year. In most cases, artificial insemination actually costs less than natural mating. The average cost of keeping a bull on the farm is $190 per year. This includes feed, pasture, and labor but does not include the purchase price of the bull. A dairyman in Louisiana can breed a herd of 30 cows artificially for $150 per year or less. This would result in a saving of $40 per year over and above the original cost of the bull. The price of a well-bred young bull ranges between $400 and $2,000, depending upon the breed, pedigree, bloodline, and age. Well-proved sires range in price from $2,000 to $15,000.

5. With artificial insemination, the dairyman can breed his cows to several bulls. Breeding all of your cows to one bull is like "putting all of your eggs in one basket."

6. Yearling heifers or small cows may be bred to large bulls without difficulty or injury. In natural mating, many dairymen keep an extra young bull to breed to heifers. This is not necessary in artificial insemination.

7. The transmitting ability of a bull can be determined quickly and more effectively in artificial insemination. Proof based upon the production of artificially sired daughters located in many different herds is much more reliable than natural proof where the daughters are tested in one or two herds.

8. Selective mating of outstanding animals, located thousands of miles apart, is possible. Several Louisiana breeders have obtained fresh and frozen semen from outstanding bulls located throughout the United States for special matings.

9. In most cases, more complete breeding and calving records are kept when cows are bred artificially.

10. A dairyman can keep several different breeds without any added expense. In natural mating, he would need a bull for each breed of cows or would be forced to practice crossbreeding.

11. Dairymen take pride in their artificially sired heifers and, consequently, do a better job of feeding and managing them.

Limitations of Artificial Insemination

Although artificial insemination is a powerful tool for making mass improvement in the heredity of dairy cattle, certain disadvantages must be considered:

1. To be successful, all phases of artificial insemination must be carried out by a well-trained operator according to proven methods and practices.

2. Cows must be observed more closely for signs of heat and kept in or near the barn so as to be readily available for insemination.

3. In order to prevent infection and eliminate the spread of dis- ses, all equipment used must be clean, and good sanitary prac- es must be followed in each phase of the operation.

4. Artificial insemination reduces the demand for mediocre bulls it increases the demand for well-bred young bulls and desirably oved sires.

storical Aspects

Artificial insemination is old in concept but relatively new in actice. Perry (20) reported that an Italian physiologist, L. Spal- nzani, successfully inseminated a female dog in 1780. However, ore than a century passed before this new method of breeding was ed as a means of improving livestock. E. I. Ivanoff, a Russian ientist, was a pioneer in artificial insemination. He was successful inseminating mares as early as 1899 and initiated a large-scale eeding project in cattle and sheep during the years prior to World ar I. Following the war, a new livestock breeding experiment sta- n was established in Russia with Ivanoff as its first director. By 38, the Russians were inseminating 120,000 mares, 1,200,000 cat- , and 15,000,000 sheep annually.

The first cooperative artificial breeding association in the world s organized in Denmark in 1936, with 1,070 cows being bred the st year. By 1960, Denmark had many cooperative breeding asso- tions and 99 per cent of the dairy cattle were being bred artifi- lly. Artificial insemination was begun in the United States on an ganized basis in New Jersey in 1938, with 102 members and 1,050 vs enrolled. During the next few years, artificial insemination as- iations were organized throughout the United States. By January, 0, artificial insemination was being used in every state of the ion, with 64 organizations inseminating 6,932,294 cows in 946,000 ds annually. This means that one out of every three (or approxi- tely 33 per cent) of the dairy cows in the United States is being d artificially.

The exact number of beef cattle that are being bred artificially the United States is not available. However, almost all of the anized breeding associations in this country offer artificial serv- from two or three beef breeds. This program is handicapped by fact that the Angus and Hereford breed associations do not per- registration of artificially sired offspring unless both male and ale are owned by the same person. Many purebred beef breeders ctice artificial insemination in their own herds. It is permissible three or four breeders to own a bull jointly and use him to breed ebred cattle.

Research in artificial insemination was started by the Louisiana te University Dairy Department in 1943. The North Louisiana sey Breeder's Association, which was started in 1946 at Ruston,

Louisiana, was the first organized artificial insemination unit in this state. In 1946, the state Legislature appropriated funds and instructed the Dean of the LSU College of Agriculture to initiate a statewide livestock improvement program, including artificial insemination of cattle. A committee composed of livestock farmers and representatives of the extension and research divisions of the LSU College of Agriculture was appointed by the Dean and requested to make recommendations as to how this program could best be carried out. The committee recommended that a central bull stud be established on the LSU campus to service the entire state.

The Louisiana Artificial Breeding Cooperative, Inc., a companion organization to the Dairy Improvement Center, was organized July 16, 1947. This organization is a farmers' cooperative having as its main purpose the improvement of livestock through artificial insemination. Semen was first shipped from the LSU Dairy Improvement Center on October 15, 1947, to 15 local breeding circuits of the cooperative. Several other local circuits were organized shortly after the program was initiated, and a total of 12,653 cows were bred during the first year. Artificial insemination of cattle has expanded throughout the state; on January 1, 1960, there were 42 local breeding circuits employing 45 full-time technicians and with more than 51,000 cows being inseminated annually.

Louisiana has a unique artificial insemination program in that it is jointly administered by the Louisiana Artificial Breeding Cooperative, Inc., and the LSU College of Agriculture. The Dairy Department and the Agricultural Extension Service were designated to work with the Cooperative in carrying out this program.

The Dairy Improvement Center was established as a service unit of the LSU Dairy Department, with its main purpose being that of a bull stud supplying semen from outstanding bulls to organized groups throughout the state. Another function of the Center is that of conducting research. Much of the success which the artificial insemination program has achieved can be attributed to scientific investigations. Likewise, the future of this program is dependent upon the development of new and improved techniques. It is also the responsibility of the Center to receive, analyze, and file all artificial insemination records. Other responsibilities of the Center consist of assisting with the training and in the certification of breeding technicians and in teaching students enrolled in the College of Agriculture.

The Extension Service, through its dairy specialists and agricultural agents, is responsible for the organizational, educational, and promotional phases of the work. It is also responsible for assisting with the selecting of bulls, training technicians, and giving technical assistance and supervision to the breeding technicians in the field.

Structure and Functions of the Reproductive Organs

A general knowledge of the structure and functions of the male and female reproductive organs is essential in order to master the technique of artificial insemination. The reproductive processes in both the male and female are controlled by hormones produced by internal glands. These organs are called endocrine glands because their secretion is liberated directly into the blood stream.

Of the many known endocrine glands, the pituitary is considered to be the master gland since it influences or regulates many of the other glands. The pituitary gland is a small body enclosed in a bony structure at the base of the brain. It is divided into two lobes, the anterior and posterior. Secretions from the anterior lobe are best known for their effect on growth, sex glands, and milk secretion. As the animal reaches sexual maturity, the gonads, both testicles and ovaries, are activated by secretions from the pituitary gland. In the male, the gonadotropic hormone known as "F.S.H.," or follicle stimulating hormone, stimulates the male germ cells to produce spermatozoa. A second gonadotropic hormone, which is known as "I.C.S.H." or interstitial cell stimulating hormone, stimulates the testicles to produce the male hormone which is known as testosterone. Similarly in the female, the gonadotropic hormone "F.S.H." stimulates follicle growth in the ovary. As the follicle develops, the estrogenic hormone known as estradiol or estrogen is produced. The presence of estrogen in the blood stream stimulates the anterior pituitary to secrete a second hormone known as "L.H.," or luteinizing hormone. This hormone causes ovulation and stimulates growth of the granulosa cells to form the corpus luteum, or yellow body.

Male Reproductive Organs

The principal organs of reproduction in the male consist of the testicles, which are carried outside of the body in the scrotum. Spermatozoa are formed in a network of tubules located inside the testicles, and the male hormone, testosterone, is produced by the cells of Leydig (interstitial cells) which are found between the tubules. The development and behavior of the male are greatly affected by testosterone. Its chief functions are development of secondary sex characters, sex drive, and development and maintenance of the reproductive organs. Attached to each testicle is a coiled tube, the epididymis, which extends down the outside of the testicle to its base. Spermatozoa pass from the testicle to the epididymis, where they undergo a maturing process. Leading upward from the epididymis is a tube, the vas deferens, connecting with the urethra which passes through the penis and provides an opening to the exterior for ejaculation of semen and the passage of urine. The upper end of each vas deferens enlarges to form the ampulla, where spermatozoa are stored until ejaculation occurs. Located on either side of the

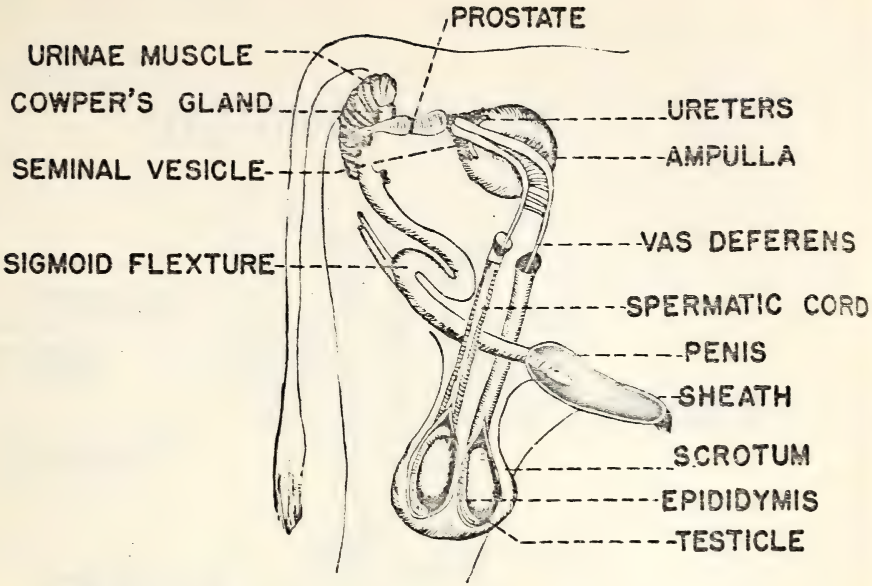


FIG. 1.— Reproductive organs of the bull.

ampullae are the seminal vesicles, which are the largest of the accessory glands. They produce a fluid containing fructose and citric acid which mixes with the spermatozoa and serves as a carrier. Other accessory glands include the prostate, which surrounds the urethra near the neck of the bladder, and the Cowper's glands located on either side of the urethra. These glands also secrete a fluid which serves as a carrier of the sperm. The prostatic secretion is alkaline in nature and is thought to be of value in neutralizing any acid condition that might be present in the urethra and vagina.

The penis of the mature bull is about one inch in diameter and three feet in length. Behind and slightly above the testicles, the penis forms an "S" shaped curve, the sigmoid flexure, which takes up about one foot of the organ when it is in the relaxed state. During natural mating or when semen is collected with the artificial vagina the curve is extended. Functions of the penis are to drain the bladder of urine and to introduce semen into the vagina of the cow. Semen is the normal discharge of the male during mating. It is whitish, milk-like fluid which consists of the spermatozoa and the secretions from the seminal vesicles and the prostate and Cowper's glands. Spermatozoa are extremely small, being less than 1/500 an inch in length, and shaped somewhat like a tadpole.

Female Reproductive Organs

The female reproductive tract is very complex; it not only produces the ovum (egg), but provides for the nourishment and grow

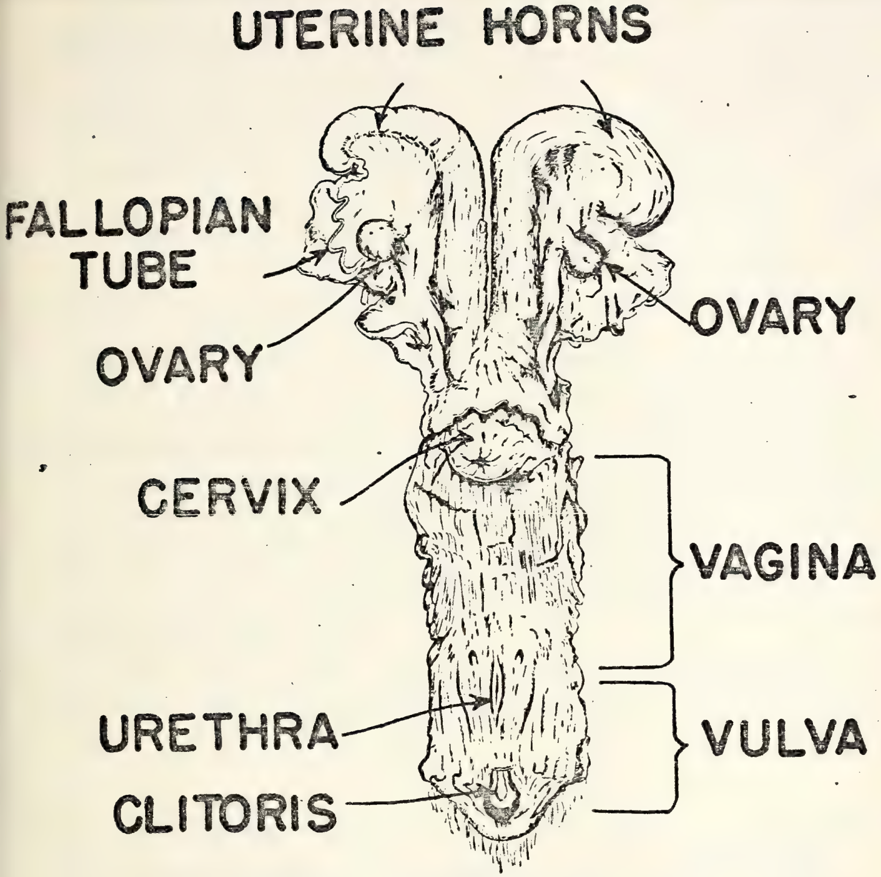


FIG. 2.—Reproductive organs of the cow.

of the fetus and at the end of pregnancy, expels the fully developed calf weighing up to 100 pounds or more. The essential organs of reproduction in a cow include the ovaries, oviducts, uterus, vagina, and vulva, as shown in Figure 2.

The two ovaries of the cow are located in the pelvic cavity suspended in the broad ligament. These organs vary considerably in shape and size but in general they are shaped like a slightly thickened lima bean, measuring 1½ inches x 1 inch x one-half inch. Germinal epithelium covers the surface of the ovary except at the point of attachment. This epithelium, together with the supporting connective tissue, makes up the outer layer (cortex) of the ovary. The inner layer (medulla) is composed of blood vessels, nerves, and connective tissue. The ovaries have a dual function. They not only provide the reproductive cells (ova or eggs) but produce hormones which prepare the tract to receive the fertilized egg, supply nourish-

ment, carry the fetus throughout pregnancy, and expel the fully developed calf.

Production of ova is a continuous process which starts before birth and extends throughout sexual life. An ovum develops from the germinal epithelium and soon becomes enclosed in a structure known as the ovarian follicle. At first the follicle consists of a single layer of cells surrounding the ovum. The follicle increases in size by multiplication of the epithelial cells and a special formation of the surrounding connective tissue. As growth continues, a cavity is formed which is filled with a light brown, alkaline fluid, the follicular fluid. Immature follicles range in size up to ½ inch in diameter. When the follicle reaches maturity, it is approximately ¾ inch in diameter and has the appearance of a blister. Normally only one follicle reaches maturity at a single heat period. It is generally believed that immature follicles degenerate, with new ones being formed for the next heat period. Ovulation takes place by the rupture of the follicle at the ovarian surface, and the ovum is washed out by follicular fluid into the upper end of the oviduct, where it is soon ready to be fertilized by the male sex cell. Immediately following ovulation, the corpus luteum (yellow body) forms from the walls of the follicle. It reaches maximum size (¾ inch to 1 inch in diameter) in 10 days and degenerates rapidly after 18 days unless conception takes place, in which case it remains fully developed throughout pregnancy.

The ovum is about 1/200 of an inch in diameter and can barely be seen with the naked eye. It is estimated that two million ova could be placed in a thimble.

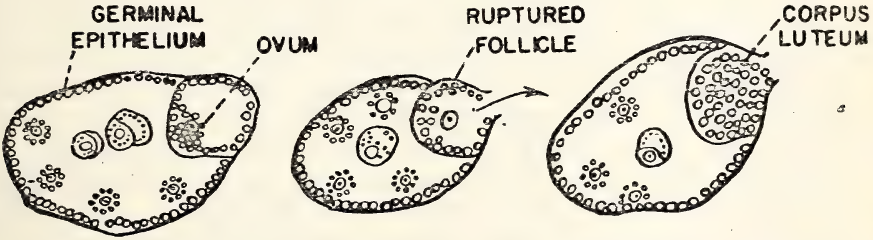


FIG. 3.—Sketch showing ovaries at various stages of the estrus cycle.

The oviducts are 8 to 10 inches long and about one-tent of an inch in diameter. One end of the tube is a continuation of t uterine horn. The other end enlarges and fans out to form th fimbria, which serves as a funnel to catch the egg when it is r- leased. These tubes contain no glands and practically no cillia. T spermatozoa and fertilized egg are transported by muscular co tractions. Fertilization occurs in the upper end of the tube soon af

ulation, with 4 to 6 days being required for the fertilized egg to reach the uterus.

The uterus consists of the body and two horns. The body is approximately 1½ inches long, but from the outside appearance, it looks to be 3 to 5 inches longer because of the close attachment of the horns. The horns are about 15 inches long and 1 to 1¾ inches in diameter. They taper and curve downwards and backwards, as shown in Figure 2.

The lining of the uterus has about 100 slightly raised areas which are known as "caruncles" or "cotyledons." During pregnancy, the cotyledons enlarge and take on a sponge-like texture to receive the villi of the fetal membrane.

The cervix serves as a barrier between the uterus and the vagina. This organ is composed of very thick muscular walls and is about 3 to 4 inches in length and 1 inch in diameter. The narrow canal has many longitudinal folds and 3 or 4 transverse folds, which makes the introduction of any instrument rather difficult. The cervix dilates sufficiently to allow passage of the fetus at calving time. There is also a slight relaxation of the cervix during estrus. This organ contains a large number of secreting cells and is the chief source of mucus during the heat period. During pregnancy, it is filled with a thick mucus plug which is referred to as the "cervical seal of pregnancy."

The vagina is 8 to 10 inches long and has many lengthwise folds. Transverse folds may be produced by abdominal straining. If these folds interfere with the passage of the inseminating tube, the cervix may be grasped and pushed forward. The posterior constrictor muscle which is found at the junction of the vagina and vulva serves to prevent the flow of urine forward into the vagina. The vagina receives the penis of the bull in natural mating and serves as a birth canal at parturition. The vulva is 4 to 5 inches long and serves as the external opening of the reproductive and urinary tracts. A small erectile organ, the clitoris, is located just inside the vulva. It is 4 to 5 inches long, but only the pointed end is visible in the vulva.

Hormones produced by the ovary play a very important role in regulating the reproductive processes. Estrogen is produced by the developing follicle of the ovary. Its chief functions are as follows: development of secondary sex characters, increase blood supply to the reproductive tract which stimulates growth of the uterine lining and increases muscle tone in the Fallopian tubes and uterine wall, aid in mammary development, and bring cow into heat. Progesterone is produced by the corpus luteum and has as its functions the preparation of the uterus to receive the fertilized egg, prevention of estrus and ovulation during pregnancy, and aid in the development of the mammary gland.

Reproductive Events

Puberty may be defined as the age at which the reproductive organs become functional. Most heifers experience their first estrus or heat period at 6 to 8 months of age. However, the attainment of sexual maturity is a gradual process, and puberty does not indicate full reproductive capacity.

A large majority of the non-pregnant cows come in heat every 18 to 24 days, with an average of 21 days. Unbred heifers have an average cycle length of 20 days, with 85 per cent falling between 18 and 22 days. The length of the heat period ranges from 2½ to 28 hours, with an average of 16 hours for heifers and 18 hours for cows. Work in progress at this station indicates that the duration of estrus in Louisiana may be somewhat shorter than that reported above. Symptoms of heat are restlessness, a tendency to mount or allowing other cows to mount, and a slight swelling and redness of the vulva, with a flow of clear mucus. Standing when mounted by another animal is the most accurate sign of estrus. Ovulation occurs 3 to 18 hours after the end of heat, the average being 10 to 12 hours for both cows and heifers.

The physiological processes of reproduction may be summarized as follows: (1) development of the follicle, (2) estrus or heat, (3) copulation or insemination, (4) ovulation, (5) fertilization, (6) formation of corpus luteum or yellow body, (7) implantation of fertilized egg, (8) gestation or pregnancy, (9) parturition, (10) lactation, and (11) absorption of the corpus luteum.

Collecting, Evaluating, Processing, and Shipping Bull Semen

Good quality semen is one of the primary requirements for success in artificial insemination. In order to obtain maximum breeding efficiency, it is necessary to use the correct techniques and sanitary precautions.

Collection of Semen

The three recognized methods of collecting semen from the bull are as follows: use of artificial vagina, the massaging of the ampullae, and electro-ejaculation (13). Use of the artificial vagina is the most satisfactory method of collecting semen from the bull and is universally practiced in artificial breeding associations and private herds. The artificial vagina consists of a heavy rubber cylinder [illegible] inches long and 2¾ inches in diameter with a thin rubber tubing folding over each end and secured with heavy rubber bands. A funnel-shaped piece of rubber tubing is slipped over one end of the vagina and held by a heavy rubber band. The sterile collecting tube, which is attached to the small end of the funnel, is usually covered with

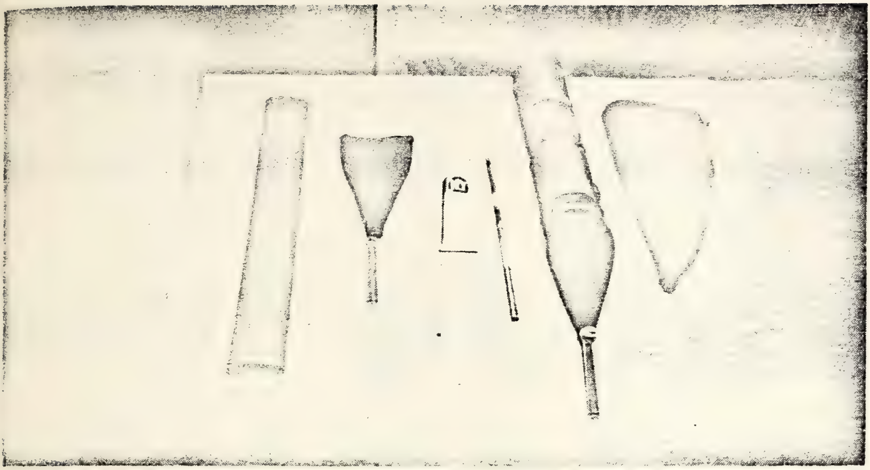


FIG. 4.—Equipment used in collecting semen. Left to right: rubber cylinder and bands, inner liner, funnel and graduated tube, lubricating jelly, glass rod for applying lubricant, artifical vagina assembled, and protector jacket.

flannel or paper towels to protect the semen against cold shock. During cold weather a protector jacket or a special type artificial vagina is used to prevent cold shock.

The desired temperature and pressure is usually obtained by filling the outer jacket about three-fourths full of water at a temperature of 120° F. For most bulls, the correct temperature of the inside of the vagina at the time of collection is 105° to 110° F. A thin coat of sterile lubricant such as KY jelly is spread over the upper one-half of the inner lining by means of a sterile glass rod just prior to collection. A quiet cow or a steer is commonly used for the bull to mount at the time of collection. Immediately before collection, the area around the sheath is washed with a solution containing 200 parts of chlorine per million to reduce bacterial contamination of the semen.

After proper stimulation, the bull is allowed to mount the cow, at which time the attendant places his hand on the sheath and directs the penis into the artificial vagina. As the bull makes his thrust, the semen is deposited in the funnel and collecting tube. Studies made at this station (6) showed that the average volume of semen per ejaculate was increased by 22 per cent and the average number of motile spermatozoa by 55 per cent when the bull was properly stimulated prior to the collection of the first ejaculate. The false mount—that is, allowing the bull to mount the dummy animal without serving—was found to be an effective method of obtaining the desired level of sexual excitement. In the false mount, the penis is guided to the side of the collection animal by the attendant.

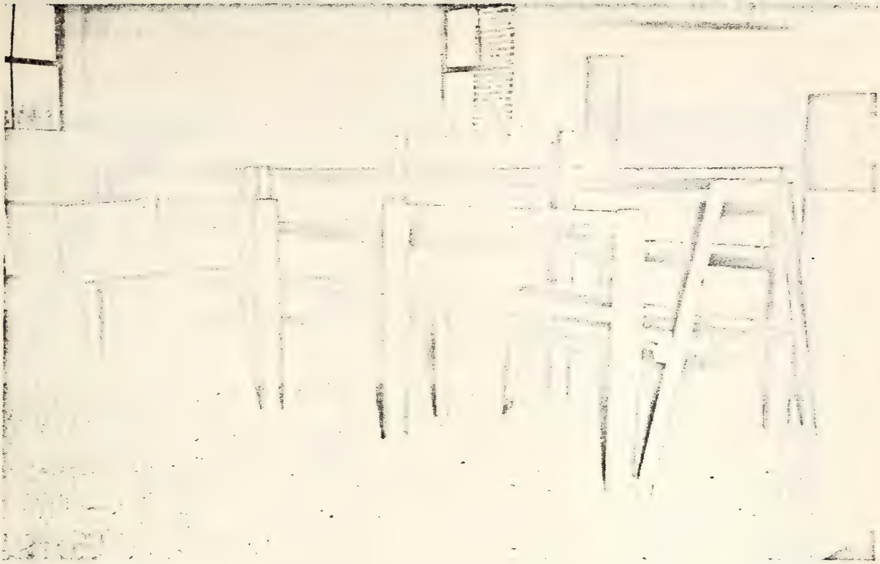


FIG. 5.—A convenient and safe semen collection chute in use at the LSU Dairy Improvement Center.

Collecting semen by massaging the ampullae is not a very satisfactory procedure, since the semen is often contaminated with urine and dirt. This method is used only where valuable bulls are unable to mount and serve the artificial vagina because of injury. Semen collected by this method has been observed to be inferior in quality and is usually less fertile than that collected by the artificial vagina. Special training is essential to obtain semen by massaging the ampullae.

Electro-ejaculation is a relatively new method of collecting semen from the bull. According to Dziuk *et al.* (11), it is possible by electrical stimulation to collect semen from some bulls that are unable or unwilling to serve an artificial vagina. Valuable animals that are old or crippled may still be used in spite of their physical handicap. Semen obtained by this method is of greater volume but of lower density. However, the total number of spermatozoa is comparable to that obtained with the artificial vagina. The electro-ejaculator has been used at this station on a limited basis with good results. Special skill is not required to operate the electro-ejaculator, and usually good results can be obtained by following the instructions of the manufacturer.

Evaluation of Semen

Much variation is observed in the quantity and quality of sem collected from different bulls and between ejaculates from the sa bull. Each sample of semen must be carefully examined to determi

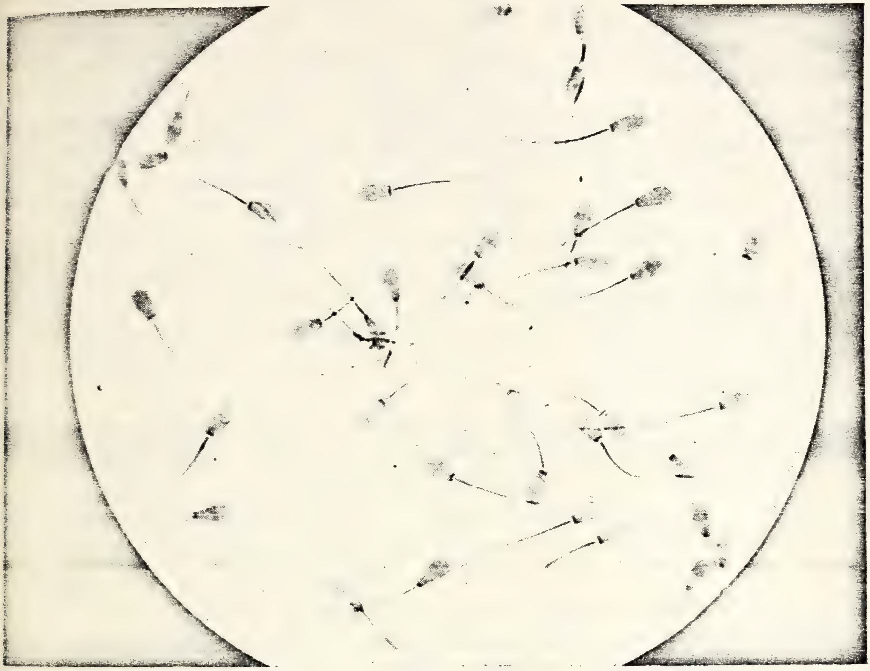


FIG. 6.—Microscopic view of spermatozoa.

its suitability for use in artificial insemination. Immediately after collection, each ejaculate should be examined to determine the general appearance, volume, per cent and rate of motility, concentration, and methylene blue reduction time. Several other tests, including pH, morphology, dead-alive staining, cold shock, incubation, and reaction rates, have been designed to measure semen quality, but they are used only to a limited extent because of the time, equipment, and skill required to make them. The methylene blue test and the determination of concentration are often omitted where artificial insemination is practiced in individual herds.

A normal semen sample is whitish-yellow with a milk-creamy consistency. Color is dependent to a large extent upon the number of spermatozoa present. A thick, cream-like sample is very high in concentration, whereas a thin, watery sample is low in density. Semen characteristics reported here are based upon some 20,000 ejaculates produced by 152 dairy and beef bulls during a nine-year period. These bulls were selected for use in artificial insemination and it is quite likely that the quality of this semen was better than that of the average of all bulls.

Semen volume per ejaculate ranges from 0.5 to 12 ml., with an average of 4.5 ml. Volume not only varies between breeds and bulls within a breed, but between ejaculates of an individual bull. As a rule, bulls of the larger breeds produce a greater volume of semen

per ejaculate, and volume usually increases with an increase in the age of the bull up to the fourth year.

The rate and percentage of forward movement of spermatozoa is observed microscopically. Progressive motility of spermatozoa ranges from 0 to 80 per cent, with an average of 50 per cent. Steps in determining progressive motility are as follows. (1) Warm a clean glass slide to approximately 100° F. A stage incubator should be used if available to keep the sample warm while it is being examined. (2) Mix semen by inverting the tube several times. Avoid vigorous agitation. (3) Place a small drop of semen on the slide with a sterile stirring rod. (4) Place a large drop of 3 per cent sodium citrate dihydrate on the slide next to the semen. (5) Mix the semen and citrate with one corner of a clean cover glass and cover the mixture with the cover glass. (6) Examine immediately, using the high power objective. Estimate the percentage of progressively motile spermatozoa to the nearest 10 per cent; that is, 40, 50, 60, 70, etc. At the same time, estimate the rate of movement. The rate ranges from 0 to 4, with 0 showing no forward movement; 1—movement is weak and very slow with little or no progressive motility; 2—shows a slow progressive movement; 3—movement is vigorous and more rapid than 2; 4—very rapid and vigorous movement. A sample containing less than 50 per cent motility or a rate of less than 3 is usually discarded.

The number of sperm per ml. normally ranges from approximately 300,000,000 to over 2,000,000,000, the average being about 1,200,000,000. There is much variation in the sperm count of semen produced by different bulls, with different ejaculates from an individual bull varying somewhat less. Concentration is very important in a large breeding association where maximum use is made of the semen. Density of the semen is somewhat less important in a private herd or in a small operation where a sample is used to breed a limited number of cows.

The conventional methylene blue reduction test, which is based upon concentration and activity of the spermatozoa, is not a good measure of potential fertility of the semen. However, the modified test which was devised by workers (7) at this station was found to be a reliable aid in measuring the initial spermatozoa activity and potential fertilizing capacity of semen. In semen that contains a high percentage of active spermatozoa, the oxygen is used at a more rapid rate than it is in a poor sample. This causes an excess of hydrogen, which combines with the methylene blue to form leuco-methylene blue, which is colorless.

Steps in making the modified methylene blue test are as follows. (1) Prepare a methylene blue solution by dissolving 50 mg. methylene blue chloride in 100 ml. of 3 per cent sodium citrate dihydrate. (2) After the concentration has been determined, place a sufficient

FIG. 7.—Evaluating semen for motility and concentration.

volume of semen to contain 240 million spermatozoa in a 10 x 75-mm. test tube and then add enough egg yolk-citrate extender to bring the total volume to 1 ml. and mix. (3) Add .1 ml. methylene blue solution (as prepared in step 1) and mix thoroughly. (4) Seal with $\frac{1}{2}$ inch layer of mineral oil. (5) Place in water bath at 115° F. and observe the time required for the sample to lose its color. Methylene blue reduction time ranges from 4 to 12 minutes, with an average of 5 to 6 minutes. A sample requiring more than 9 minutes should be discarded.

No single rapid test has been devised that will accurately and reliably measure semen quality and predict its potential fertility. However, the following combination of tests and minimum standards are recommended for use in the evaluation of bull semen: (1) initial progressive motility of at least 50 per cent; (2) a concentration of at least 500 million spermatozoa per ml.; (3) a modified methylene blue time of 9 minutes or less. Previous breeding history of the bull is also an important factor to be considered.

Cooling and Storing Semen

Handling of semen according to proven methods is of utmost importance in a modern artificial breeding organization or in a small-scale operation on a private farm. Semen should be extended (diluted) and the cooling process started immediately after collection. According to Anderson and Seath (3), any delay in this step will result in a decrease in semen quality and fertility and an increase in bacterial growth. The extending fluid and semen should be of approximately the same temperature.

Much research has been conducted with the objective of extending the livability of sperm in storage and developing improved methods of shipping and handling semen in the field. In 1945, Mayer and Lasley (16) isolated a factor in egg yolk which increased the resistance of spermatozoa to "cold shock," reduced the time in which semen could be cooled, and extended the length of time that semen would remain motile in storage. Investigators (29) at the New York Station found the optimum temperature for long-time storage of semen to be between 34° and 41° F. If semen is to be stored at 34° F., it must be cooled at a very slow rate (9° F. per 20 minutes). Studies made at this station showed a marked reduction in the motility of semen stored at a temperature ranging from 28° to 40° F. as compared to samples stored at a more constant temperature of 38° to 40° F. Although spermatozoa will live slightly longer when stored at 34° F., the most practical temperature for storing semen used in artificial insemination is 38° to 40° F.

The cooling procedure used at the LSU Dairy Improvement Center is a modification of the system developed by the Cornell University workers. As soon as the semen is collected and brought into the laboratory, it is labeled, stoppered, and placed in a 250-ml. beaker containing approximately 150 ml. of water at 80° F. Volume, per cent progressive motility, and concentration are determined, and the methylene blue test is started within five minutes after the semen is collected. Samples that meet the minimum standards for motility and concentration are pre-extended at a ratio of 1:4 with egg yolk-citrate-sulfanilamide at 80° F. The test tube containing the partially extended semen is placed in a tall 250-ml. beaker containing 200 ml. of water at 70° F. Then the beaker containing the semen is placed in a walk-in refrigerator set at 40° F. By this means, the semen is cooled gradually to 40°-45° F. in 1 hour and 30 minutes without any danger of temperature shock. The final extension should be made in a refrigerator with extender which has been cooled to 40° F. If only a small amount of semen is needed, the final extension may be made before the semen is cooled.

Semen Extenders and Rate of Extension

The purpose of extending semen is to increase the volume in order that a larger number of cows may be bred to the most valuable sires. A good extender should not only increase the volume of semen, but it should also aid in the preservation of the spermatozoa by furnishing nutrients, reducing the effects of by-products produced by the sperm, and protecting the cells against cold shock and other adverse conditions. Many different fluids have been used for extending semen; however, only a limited number of them have proved to be satisfactory.

The two extenders most widely used in this country are the egg yolk-phosphate extender developed by Phillips and Lardy (21) and

FIG. 8.—Preparation of egg yolk-citrate extender.

1940 and the egg yolk-citrate extender formulated by Salisbury, Fuller, and Willett (23) in 1941.

Although both of these extenders have been used with about equally good results, the yolk-citrate is usually preferred because the citrate disperses the fat globules in the egg yolk so that the spermatozoa can be seen more clearly under the microscope. In 1951, Thacker and Almquist (26) of the Pennsylvania Station found that the heating of pasteurized skim milk and pasteurized, homogenized milk brought about changes in these products which made them suitable for semen extenders. Spermatozoa remain motile in the boiled milk products for periods approximately equal to those extended in yolk-citrate. In preliminary field trials, these workers found that pasteurized, homogenized milk boiled for 10 minutes resulted in fertility equal to or slightly superior to that obtained from yolk-citrate extender containing 1,000 units per ml. each of penicillin and streptomycin. Shortly following this report, several artificial breeding associations tried various types of milk products as semen extenders. Wide variations in fertility were obtained from milk extenders by the various associations, and in many instances the fertility was lower than that obtained with yolk-citrate extender.

Investigators at this station compared pasteurized skim milk which was heated at 203° F. for 10 minutes with yolk-citrate. Sufficient amounts of penicillin and streptomycin were added to both extenders to give 500 units each per ml. of extended semen. Fertility, based on 30- to 60-day non-returns to first services, was 73.3 per

cent for the yolk-citrate and 70.4 per cent for the boiled skim milk. These differences were not significant. Storage motility after 72 hours was slightly, but not significantly, higher for the heated skim milk as compared to the yolk-citrate extender.

Milk extenders are more economical and much easier to prepare than either the yolk-phosphate or the yolk-citrate. The motility can be readily obtained in semen extended in skim milk, but it is difficult to see the spermatozoa under the microscope in whole milk.

There are several commercial semen extenders available through the artificial insemination supply houses. These preparations have been used successfully by individual dairymen and ranchers.

Egg Yolk-Citrate-Sulfanilamide Extender (Diluter)—To prepare egg yolk-sulfanilamide extender, use one part of egg yolk and three parts of citrate-sulfanilamide buffer and mix thoroughly. Directions for preparing these materials are given below.

Citrate-Sulfanilamide Buffer— (1) Weigh out 30 grams sodium citrate dihydrate ($Na_3C_6H_5O_7 \cdot 2H_2O$) and 4 grams sulfanilamide. (2) Place about 800 ml. of water distilled over glass in a wide-mouth flask and bring to a boil. (3) Add the citrate and sulfanilamide and mix thoroughly. (4) Allow the solution to cool to room temperature and then add enough water distilled over glass to bring the volume to 1,000 ml. (5) Mix thoroughly. (6) Store the citrate-sulfanilamide buffer in a brown jug in a dark place at room temperature until it is used. Light will destroy the sulfanilamide and turn the solution brown. It is desirable to make up a fresh supply of buffer every 2 to 3 weeks. Sulfanilamide will aid in the control of bacterial growth and may increase fertility but is not an essential part of the extender.

Egg Yolk—(1) Wash fresh eggs thoroughly in a warm detergent solution. Then rinse with warm tap water followed by a rinse in distilled water. (2) Rinse eggs in isopropyl alcohol or 70 per cent ethyl alcohol and let them dry. (3) Place a clean metal egg separator over a sterile graduated glass cylinder. (4) Break egg shell about midway of the egg on the edge of a clean beaker or jar. Transfer the yolk (yellow) from one-half of the shell to the other until all of the white is separated from the yolk. (5) Place the yolk in the separator which was prepared in step 3. Puncture the yolk membrane thoroughly with a clean glass rod and permit the yolk to run through the separator into the cylinder. (6) Discard the yolk membrane and repeat steps 4 and 5 until the desired volume of egg yolk is obtained. Several cylinders may be used if a large volume of extender is to be prepared. For best results, the extender should be made each time it is to be used and stored at 40° F.

Milk Extender—The procedure recommended by Pennsylvania workers (26) is as follows. (1) Obtain fresh, pasteurized, homogen-

zed milk or pasteurized skim milk from an established creamery. (2) Heat the milk in the top section of a pyrex glass double boiler to 203° F. Remove the thermometer, replace the lid, and continue heating for 10 minutes. (3) Remove milk from heat and allow it to cool to room temperature. (4) After cooling, pour the milk into another sterile container, leaving the scum in the boiler. It may be necessary to strain the milk through a sterile cloth. (5) Precautions: (a) any variation in the procedure may result in an unsatisfactory extender; (b) check the sperm motility during a seven-day storage period and try milk extender on a small scale before adopting it as a routine practice.

The Use of Antibiotics in Semen—All bull semen contains bacteria at the time of collection. The number of bacteria in semen collected with the artificial vagina ranges from 100 to more than 3,000,000 per ml., with an average of some 200,000 (2). Some of the forms most commonly found in semen are *diphteroids, bacilli, E. coli, pseudomonas, streptococci,* and *staphlococci*. Studies made at this station confirmed the reports of several other investigators showing no relation between number of bacteria present and fertility. However, there are certain forms of bacteria, including *pseudomonas pyocyaneus* and *hemolytic streptococci,* which are associated with low fertility. Almquist *et al.* (1) found that the addition of penicillin, streptomycin, or a combination of these materials increased the fertility of relatively infertile bulls as much as 25 per cent. Studies made at this station (9) with bulls of varying levels of fertility showed an increase of 16 per cent in fertility when 1,000 units of penicillin and streptomycin per ml. of extender were added. These materials not only increase fertility but control the bacterial flora, improve livability of spermatozoa, and act as metabolic depressors. In more recent studies 500 units of penicillin and 500 units of streptomycin per ml. of extended semen gave satisfactory results.

Preparation of Antibiotic Solutions. PENICILLIN—Add 19.5 ml. of 3 per cent sodium citrate buffer to a bottle containing 2,000,000 units of crystalline penicillin "G" and shake until all crystals are dissolved. This solution will remain active for seven days if stored at 40° F.

STREPTOMYCIN—Add 47.5 ml. of 3 per cent sodium citrate to a bottle containing five grams of streptomycin sulphate and shake until the material is completely dissolved. Streptomycin requires more vigorous shaking than penicillin. Streptomycin is more stable than penicillin and will remain active for 14 days if stored at 40° F. Both of these materials can be made up in smaller quantities if desired. Each of the above solutions contains 100,000 units per ml. Add one-half ml. of the penicillin solution and one-half ml. of the streptomycin solution per 100 ml. of extended semen. This will pro-

vide 500 units of penicillin and 500 units of streptomycin per ml. of extended semen.

Rate of Extending Semen—Semen contains varying numbers of spermatozoa at the time of collection. Several investigators, including Salisbury (22), have reported that high quality semen can be extended 1:100 without any decline in fertility. Many artificial breeding associations are obtaining good results with semen extended at a ratio of 1:100. If maximum use is to be made of the semen obtained from the most valuable bulls, it is much more logical to extend on the basis of numbers of motile spermatozoa. Studies made at this station (8) show a higher rate of fertility for semen with a high initial concentration as compared to samples with lower initial concentrations when the semen was extended by volume. However, when semen was extended on the basis of numbers of motile sperm, samples with a low initial concentration gave results equal to those with higher initial sperm counts.

An experiment was conducted at this station whereby semen was extended to contain 12, 6, and 2 million motile sperm per ml. Fertility based on 60- to 90-day non-returns to first services was 63.6, 64.5, and 58.2 per cent respectively for the three extension rates. New York workers (10) obtained a slight decline in fertility when semen was extended to contain 5 million motile sperm as compared to samples containing 10 million or more motile sperm per ml. Thus, it would appear that the threshold is somewhere between 5 and 6 million motile spermatozoa per ml. of extended semen or per insemination.

Where artificial insemination is being practiced on a small scale, such as on a private farm, there is no advantage in determining the concentration. Research has shown that good results can be obtained when the semen is extended according to volume. Many people make the mistake of extending semen at a very low ratio, such as 1:4 or 1:10. When semen is extended 1:25, the sperm will live longer than they will in a lower extension ratio and there is less chance of spreading disease such as *Vibrio fetus*. If the motility is 50 per cent or more, there is an adequate number of sperm present in semen extended 1:25 to result in maximum fertility unless the sample is extremely low in concentration.

Shipping and Handling Liquid Semen Under Field Conditions

In packing semen for shipment, the most important requirements are (a) adequate refrigeration, (b) insulation against outside temperature, (c) protection of semen tubes against breakage, and (d) insulation to prevent the semen from getting too cold. Missouri workers (14) found that an insulated corrugated cardboard box 6 inches x 6 inches x 12 inches was satisfactory for making overnight semen shipments. The prepared tubes of semen were wrapped in

several thicknesses of paper and enclosed in a "Jiffy Wrapper" with a can of ice. Then the insulated wrapper containing the semen and refrigerant were inserted into the cardboard box and sealed.

A modification of the Missouri packaging procedure is used at this station. Steps used in packaging semen are: (1) After the semen has been evaluated, extended, and cooled to 40° F., it is poured in properly labeled plastic tubes and capped. The tubes are wrapped in four thicknesses of paper towel and then a piece of corrugated cardboard 4 inches x 6 inches is folded around the bundle of tubes and secured with a rubber band. (2) The tubes enclosed in the cardboard are placed between two number two cans of ice in a pre-cooled quart size "Jiffy Bag." (3) After the bag has been folded at the top, it is inserted in a pre-cooled 5 inches x 5 inches x 11 inches corrugated cardboard box insulated with a "Jiffy Liner," and the box sealed. Semen packaged in this manner will maintain a constant temperature of 38° to 40° F. for 18 hours or longer.

Handling semen properly is one of the most important phases of the breeding technician's work. In order for the technician to obtain the best breeding results, the semen must be stored and handled according to approved procedures. There are several commercial kits on the market which will keep the semen at the desired temperature of 38° to 40° F. if they are properly iced. The ice chest in any kit that is used should be equipped with a thermometer so that the technician can check at regular intervals to make sure that the semen is being maintained at the desired temperature at all times.

The following procedure for handling semen has been found to give good results: (1) Upon arrival of the semen, open the package and check the cans to see if they still contain ice; if so, the temperature of the semen is very likely to be under 45° F. (2) If all the ice in the can is melted, then the temperature should be determined by inserting a thermometer between the tubes of semen and letting it remain for five minutes. The tubes of semen and cans should be placed back in the bag and the carton should be closed during this period. If the temperature is 45° F. or lower, the tubes of semen may be placed in the ice chest, which should be between 38° and 42° F. However, if the semen arrives at a temperature above 45° F., the tubes should be placed in a glass of water near the temperature of the semen and cooled gradually at a rate of 1° F. every two minutes. (See cooling procedure in another section of this bulletin.) (3) It is a good practice to examine the semen to determine the motility each day. (4) Semen more than three days old and samples which have been exposed to high or low temperatures should always be examined before using. (5) Check the temperature of the ice chest at regular intervals; the temperature should be betwen 38° and 42° for best results. (6) Never allow water to remain in the metal tubes in the ice chest. Air around the tubes of semen aids in preventing cold

shock. (7) Always use coil springs in metal tubes to push up tubes and prevent breakage. (8) Keep semen clean and avoid excessive shaking.

Tubes of semen may be stored in a refrigerator. The temperature of the semen will remain more constant if the tube is placed in a beaker or glass containing enough water to cover the lower half. A thermometer should be placed in the glass so that the temperature can be checked from time to time.

A wide-mouth thermos bottle can be used in place of an ice chest in a small artificial insemination operation, such as on a private farm. Several holes can be bored in the cork to provide a place for carrying the semen tubes. Water in the thermos should be 38° F. If the thermos is used, a small metal chest similar to the regular inseminating kit will be needed to carry the tubes, syringes, and other inseminating supplies.

Processing, Storing, and Using Frozen Semen

The freezing and long-time storage of semen offers a new and useful tool to purebred dairy and beef breeders as well as commercial operators. These farmers with genetically superior animals will be able to increase the usefulness of their sires and follow a more intelligent mating system through the proper application of a semen freezing program. In Louisiana, as in most subtropical and tropical regions, many sires experience low semen quality during the hot and humid summer months. This degenerative change in semen production may last into the fall and early winter months. In particular instances, the effects of hot weather may be severe enough to cause permanent damage to the reproductive organs of a bull; however, in most cases those animals that are affected recover by early spring.

During the periods of low quality semen production, the fertility level will normally decrease in proportion to the extent the semen quality has been affected. Thus, the possibility of a breeder's freezing semen during the spring when semen quality is high and storing it for periods up to a year or longer will in many instances prove to be an economical and sound approach to a planned mating program. The following information concerning frozen semen is intended to familiarize the breeder with the more important technical aspects of freezing, storing, and using frozen semen. Certain phases, such as storing, may be carried out by the breeder, but only those well trained in the procedure of semen collection and processing should undertake the actual freezing of semen. In some instances the breeder will be able to contract with a commercial or state organization for the collecting and freezing, and in some cases even the storing of the frozen semen.

The information presented is in part based on knowledge gained from practical investigations with frozen semen conducted at LSU and from research work at the New Jersey Experiment Station (17) and breeding associations throughout the country.

Preparation of Extender and Freezing of Semen

Semen for freezing can be extended in either egg yolk-citrate or milk extender. Egg yolk-citrate extender has been used primarily in Louisiana for both laboratory and field studies.

Preparation of Egg Yolk-Citrate-Glycerol Extender—Prepare a 3 per cent sodium citrate dihydrate buffer solution. This solution may be kept several weeks under refrigeration. To the buffer solution (warm to 30° C. prior to using), add egg yolk at the ratio of 1:4 and 1,000 micrograms of streptomycin sulfate per ml. of extender prepared; mix thoroughly. This portion of the extender will be referred to as solution A.

In another flask prepare a solution containing 66 per cent buffer solution, 20 per cent egg yolk, and 14 per cent glycerol; mix thoroughly. This portion of the extender will be referred to as solution B.

Extending, Cooling, and Equilibration—Following microscopic evaluation, extend the semen sample in solution A at 30° C. Semen used for freezing should contain a minimum of 50 per cent motile spermatozoa. Extend semen that is of average concentration 1:20. When an accurate determination of the concentration can be made, extend at the rate of 30 million live sperm per ml. The extended semen is then cooled slowly at 5° C. over a period of 2 to 3 hours. To accomplish this, put the tube of extended semen in a tall 250-ml. beaker approximately three quarters full of tap water at 30° C. Next, place in a refrigerator or walk-in cooler where the temperature is controlled at 5° C. After the semen is cooled to 5° C., add an equal volume of solution B at 5° C. in five equal aliquots over a period of 30 minutes. Allow an 18-hour equilibration period before starting the freezing process.

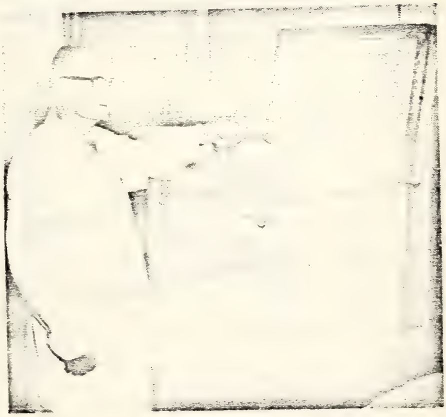


Fig. 9.—Dry ice and alcohol method of freezing semen.

The final composition after equal amounts of solutions A and B are added will be 20 per cent egg yolk, 2.2 per cent sodium citrate dihydrate, 7 per cent glycerol, and 500 micrograms of streptomycin sulphate per ml. If semen is extended by volume, the final extension

rate will be 1:40, or 15 million live spermatozoa per ml. when extended according to spermatozoa count.

Tapered pyrex glass ampoules have been found to be most satisfactory for packaging semen into individual 1-ml. inseminates. For permanent identification, use a glass-marking ink or alcohol resistant tape label. Dispense 1-ml. portions of the glycerolated semen into glass ampoules. For filling a small number of ampoules, a 20-ml. syringe is convenient; with a large number of vials, an automatic syringe unit is highly desirable. Use a 14-gauge needle for best results on both types of syringes. Seal ampoules with an oxygen-gas burner. The ampoules are placed in racks and transferred to an alcohol bath at 5° C. The freezing rate is controlled by the addition of dry ice at a rate that will decrease the temperature of the alcohol bath 0.8° C. per minute between +5° C. and −15° C. and 3 to 4° C. per minute between −15° C. and −79° C.

Storage of Frozen Semen

After they have reached −79° C., the ampoules are placed in a tray containing alcohol (−79° C.) and transferred to storage facilities. The storage temperature must be maintained at −75° C. or colder. There are several types and sizes of storage containers available. The combination mechanical-dry ice chest shown in Figure 10 has proved to be economical and suitable for long-time storage of semen. The arrangement of a series of three drawers, each containing five trays, allows for easy accessibility to the semen and for a maximum capacity of 1,260 ampoules. The three drawers are housed in a perforated metal ice-retaining wall. Guides fastened to the walls allow the drawers to be pulled up with quick access to any one of the five trays. Cracked dry ice is placed between the metal retaining wall and the styrene insert and on top of the drawers. Studies made at this station with the chest shown in Figure 10 indicate that dry ice must
added at 14-day intervals. The average daily consumption of dry i
was 4.26 pounds, and the temperature in the trays ranged fr

Fig. 10.—Mechanical-dry ice frozen semen storage chest.

–77.5° to –78.5° C. Dry ice should not be allowed to drop below two-thirds capacity. This system of semen storage is particularly advantageous over mechanical refrigeration where power failures are frequent.

Several companies have mechanical freezers on the market for frozen semen storage. These units vary in size with storage capacities ranging from 1,000 ampoules upwards to 20,000. Many of the mechanical boxes have safety features, such as the automatic release of CO_2 in case of power or mechanical failure.

A dry ice storage chest as shown in Figure 11 is suitable for storage of 300 to 400 ampoules. Dry ice is placed around a retaining wall of perforated metal and in the center on top of the stored semen. A series of trays is used for convenient handling and accessibility to the semen.

Wide-mouth thermos bottles are also used for storage of small quantities of frozen semen. One-gallon vacuum thermos jars will hold up to 150 ampoules. To separate the ampoules from the dry ice, a wire-mesh divider is placed in the center of the jar. The dry ice is on one side of the divider and the ampoules are placed on the other side. Before placing the ampoules in the thermos, add one quart of alcohol and cool down with dry ice to –79° C. The thermos jars must be re-iced every two days when kept at room tempera-

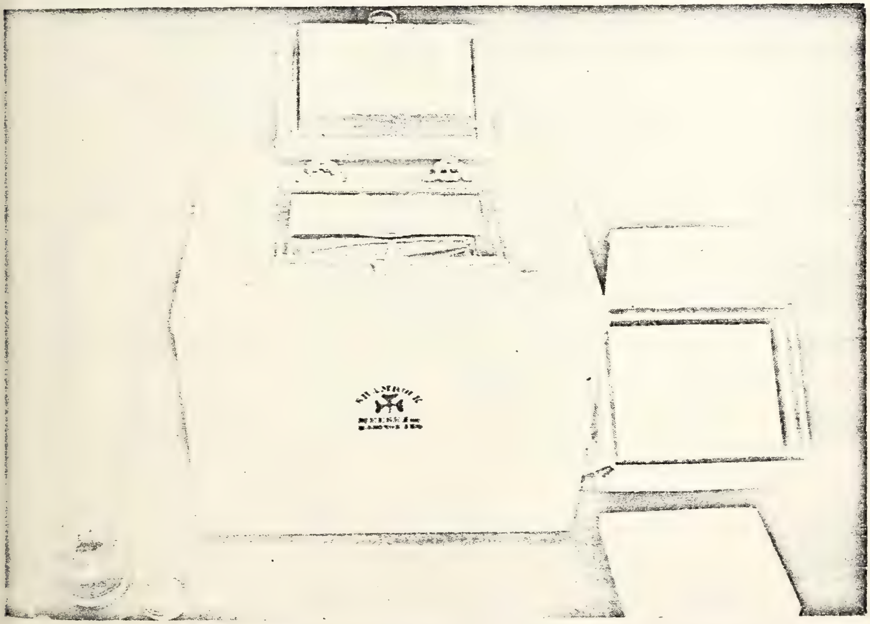


FIG. 11.—Equipment used for storing and shipping frozen semen. Shown are: wide-mouth pint thermos bottle, storage chest (400-ampoule capacity), and styrene shipping container.

ture. This interval can be extended when the jars are maintained in a deep freeze.

A wide-mouth pint thermos bottle is convenient for carrying semen to the field. Add 1/3 pint of alcohol and cool slowly to —79° C. with finely cracked dry ice. Place ampoules in cooled mixture and fill bottle with dry ice.

The styrene shipping container shown in Figure 11 has proved to be practical for shipping frozen semen. Fill the box 1/3 full of cracked dry ice. Place ampoules in a container such as a pint paint can partially filled with alcohol and secure lid tightly. The container of ampoules is then placed in the center of the dry ice. Complete filling box with dry ice. Frozen semen packaged in this manner may be shipped by air or bus.

A more recent development for semen storage is the liquid nitrogen refrigerator shown in Figure 12. The refrigerator has a capacity of 33,000 ampoules of semen and is maintained at a temperature of —196° C. Daily consumption of liquid nitrogen is approximately 7 liters, with the temperature holding time (without refilling) being about two months.

The liquid nitrogen central storage refrigerator is constructed of stainless steel, with all joints having been welded to give added strength and to insure long-lasting vacuum in the wall space. Stor-

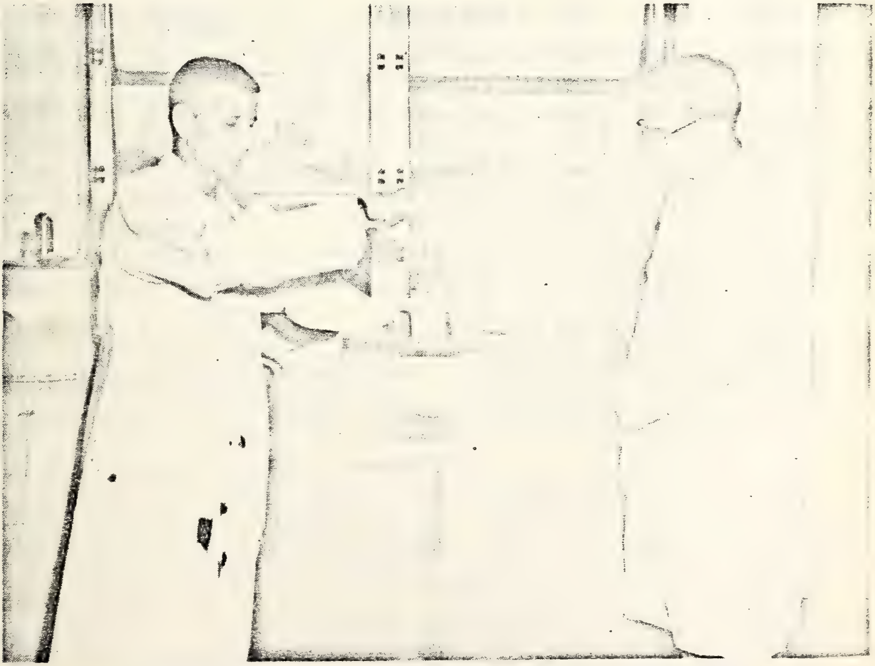


FIG. 12.—Liquid nitrogen central storage refrigerator.

ge space consists of two circular trays, each of which is divided into pie-shaped sections. The bottom tray has six usable sections but the top has only five since one section of the top tray is left open to give access to the bottom tray. Each tray can be rotated separately by means of a handwheel.

Ampoules of semen are attached to metal strips referred to as canes or racks. Each cane holds six ampoules and is marked at the top with the code number of the bull. Canes of semen are packed in cartons 2½" x 2½" x 11", with the top left open. Each carton holds 20 canes, or 120 ampoules. Each pie-shaped section of the trays holds 25 cartons. An ampoule, cane, or carton of semen can be removed without exposing any of the others to the outside temperature.

There are many other types of storage boxes and containers on the market. Some of these products have been tried experimentally and have proved satisfactory under certain conditions. The major points to consider when purchasing such equipment are the reliability of the manufacturer, electric and dry ice consumption, accessibility of the ampoules, and a storage temperature of —75° C. or colder.

Care and Use of Frozen Semen in the Field

To insure high fertility with frozen semen, the exact procedure for freezing, storing and field use must be followed. The frozen semen must be maintained at —75° C. or lower at all times prior to its use. The liquid nitrogen field refrigerator shown in Figure 13 is being used throughout the United States and has proved to be entirely satisfactory for a technician inseminating 1,000 to 3,000 cows a year. Construction is similar to that of the central storage container. The portable field refrigerator holds 504 ampoules of semen, which is maintained at —196° C. This refrigerator uses about 1 1/3 liters of nitrogen daily and must be refilled every 14 to 21 days. Semen is stored on canes in metal canisters or baskets. Each of the six canisters holds 14 canes, or 84 ampoules, of semen. A single ampoule of semen can be removed without exposing any of the other semen to outside temperature.

Investigations at this and other stations show that semen stored in liquid nitrogen has a slightly higher percentage of motile sperm after thawing as compared to storage in dry ice. Most investigators also agree that there is some improvement in fertility with storage temperatures of —196° C. Liquid nitrogen storage equipment facilitates the handling of semen both by the technician and laboratory personnel, since it is well below the critical temperature.

To thaw frozen semen, place the ampoule in a pint jar of water adjusted to 5° C. After thawing, blot dry with paper towel and scratch the ampoule at the constriction with a small file. Place a

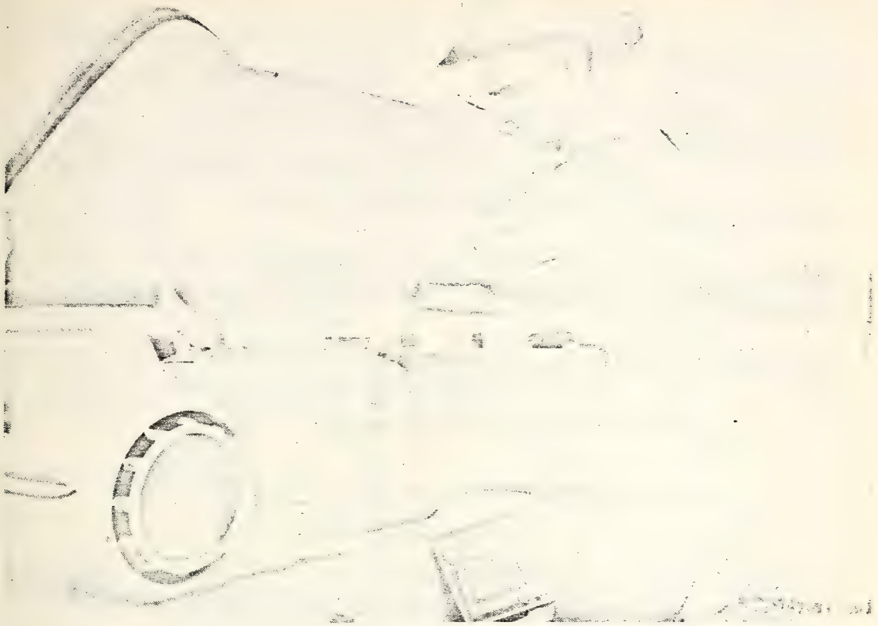


FIG. 13.—Liquid nitrogen field refrigerator.

paper towel over the tip of the ampoule and snap off the top. The opening at the break is of sufficient size to allow the insemination tube to pass.

In order to compare fresh and frozen semen under Louisiana conditions, a field trial (15) involving 6 bulls and 18 technicians was conducted. A portion of the semen from each bull was extended to contain 10 million live sperm per ml. and used in the liquid state over a three-day period. The remainder of each sample was extended to contain 15 million live sperm per ml. and frozen. Antibiotics were added to both extenders at the rate of 500 units of streptomycin and penicillin per ml. of extended liquid semen and 500 micrograms of streptomycin per ml. of extended frozen semen. A total of 119 cows was bred with fresh semen and 194 with frozen semen. Fertility, based on 60- to 90-day non-returns to first services was 68.9 for the fresh and 68.0 per cent for the frozen semen. Several artificial breeding associations in the United States, Canada, and England have reported equally good results from liquid and frozen semen. However, better trained and more closely supervised technicians are required when frozen semen is used.

Suggestions and Precautions Regarding Frozen Semen

1. Use semen of high quality for freezing.
2. Second ejaculates normally freeze better than first ejaculates

3. Semen samples from the same bull may vary as to percentage of recovery after freezing.
4. Semen in storage shows a gradual decline in motility even at −78° C.; however, a much greater decline is noticed at storage temperatures ranging from −65° to −70° C.
5. Cool down storage containers at least 24 hours prior to adding semen.
6. When transferring frozen semen, do it as quickly as possible. A slight change in temperature may affect the future storage qualities of the semen.
7. Maintain an adequate supply of dry ice in storage containers to insure proper storage temperature.
8. Do not refreeze semen, even if only partially thawed.

Insemination of the Cow and Determination of Pregnancy

Artificial insemination is a skill which can only be mastered by training and experience. The length of time required for a breeding technician to reach maximum efficiency varies from 2 to 6 months depending upon the interest, background, and ability of the individual. A general knowledge of the structure and functions of the reproductive organs is essential.

Methods of Insemination

Three basic methods of artificial insemination are vaginal, shallow cervical (speculum), and deep cervical or intra-uterine. Each of these methods is discussed below.

Vaginal Method—In the vaginal method of insemination, the semen is deposited in the anterior portion of the vagina, just below the cervix, with the aid of an inseminating tube and syringe. This procedure is very simple and requires a minimum amount of equipment, but it has not proved to give a satisfactory conception rate. Thus, it has little or no place in an organized artificial breeding program.

Shallow Cervical Method (Speculum)—In the shallow cervical method of insemination, the semen is deposited in the opening of the cervix with the use of a glass speculum and a plastic or glass inseminating tube and syringe. After the speculum has been placed in the vagina, the cervix can be located with the aid of a small flashlight or headlight. The shallow cervical or speculum method of insemination was used extensively in former years with a fair degree of success. However, with the rapid development of artificial insemination in the United States, the speculum technique has been replaced by the more efficient intra-uterine method. In research at the Missouri station (28) the intra-uterine technique resulted in a 10 to 12 per cent higher breeding efficiency than the speculum method.

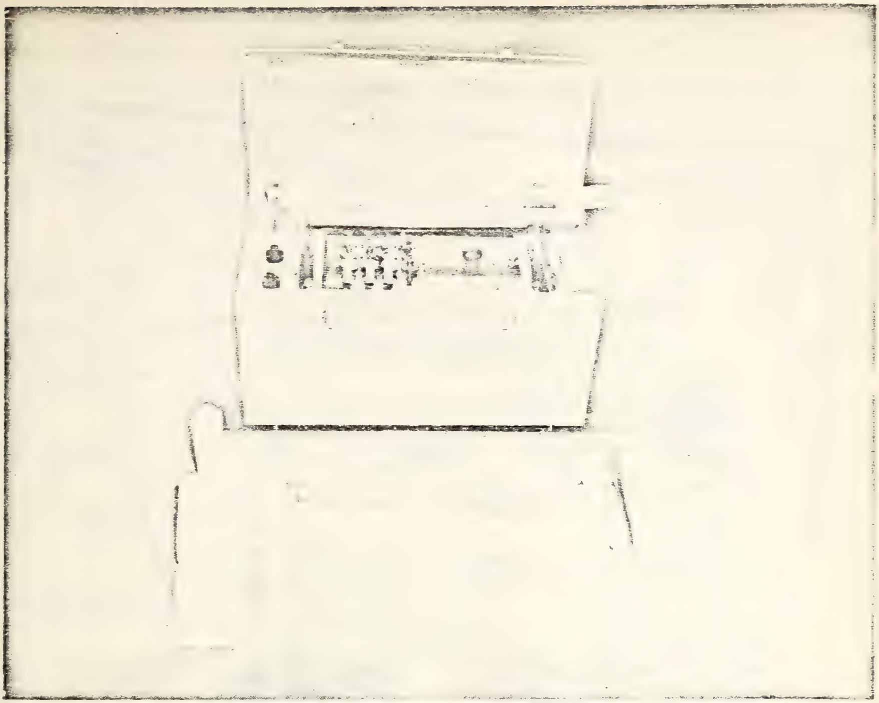


FIG. 14.—Equipment and supplies used in inseminating the cow.

Deep Cervical or Intra-Uterine Method—This method of insemination has given very good results and is being used almost exclusively in the United States and several of the European countries. Equipment and supplies used in this method are as follows: inseminating kit (including ice chest), 5-mm. disposable plastic inseminating tubes, 1-ml. plastic or rubber disposable syringes, 21-inch latex rubber glove, fabric or rubber sleeve, good quality cake soap such as Ivory, good quality disinfectant such as Creolin, talcum powder, paper towels or absorbent cotton, rubber boots or rubber overshoes, pail and brush for washing and disinfecting gloves and boots, notebook cover (three-ring notebook for individual farmer's herd records), indelible pencil, Purebred Dairy Cattle Association approved breeding receipts, and microscope (slides and cover glasses).

Steps used in the deep cervical or intra-uterine technique are as follows:

1. *Identification of the Cow to Be Inseminated*—This does not usually present a problem if the owner or a member of his family is available to point out the animal to be bred. All members should be provided with identification tags to be used on the cow when they have to be away from the farm. The cow to be inseminated should be placed in a stall or small lot when she is found in heat. This w

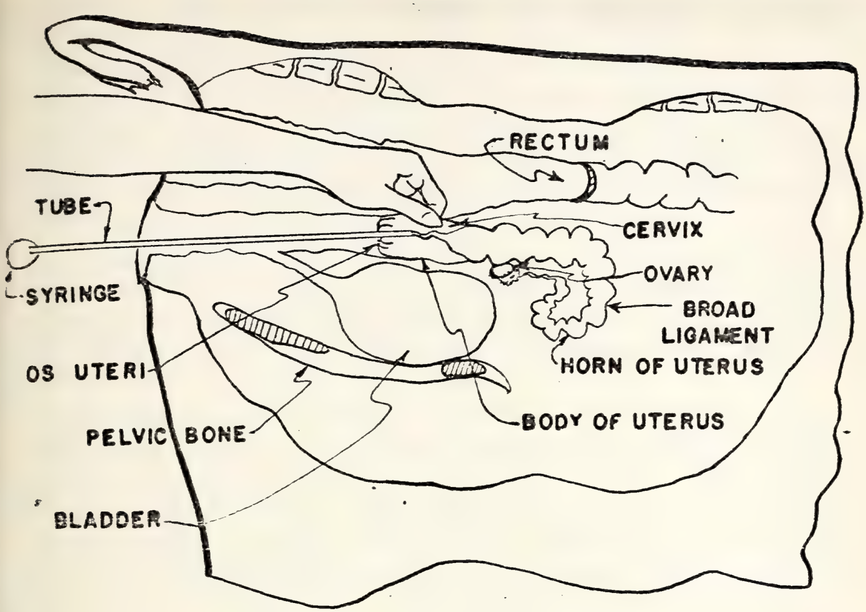


FIG. 15.—Diagrammatic drawing showing the technique used in making the deep cervical insemination.

avoid excitement of the cow just prior to insemination and eliminate unnecessary delay of the technician. All grade cows must be identified by ear tag or some other permanent number such as a neck chain or tattoo. Purebred cows must be identified by checking registration papers against the color markings or tattoo of the cow. If the papers are not available, the tattoo number or a sketch showing the color markings should be used for temporary identification. It is the responsibility of the owner to have the papers or a sketch of the color markings available when the breeding technician arrives. (See Purebred Dairy Cattle Association rules for complete information on inseminating purebred cows.)

2. *Restrain the Cow*—The cow should be properly restrained in a stanchion or tie stall before insemination is attempted. It is very important to handle the cow gently prior to, during, and immediately after insemination. Excitement or rough treatment will reduce the rate of conception.

3. *Clean the Vulva*—Clean and dry the vulva and surrounding area with a paper towel or absorbent cotton.

4. *Prepare Inseminating Tube and Draw Up Semen*—(a) Remove inseminating tube from metal speculum, being careful not to touch it except near the end where the syringe is to be attached. (b) Obtain a rubber or plastic syringe from the sterile glass jar and attach

it to the tube. (c) Remove tube of semen to be used from ice chest and check label carefully for name and number of bull. (d) Mix semen by gently inverting the tube several times. Avoid vigorous shaking of the semen, as this will injure the sperm. (e) Remove the cap and draw 1 ml. of semen into the inseminating tube. Replace the cap, put the tube of semen back in the ice chest and replace the snap-tite rubber stopper. (f) Place the prepared tube and syringe on hooks in the lid of the kit or hold it in the mouth. If hooks are used for this purpose, they should be cleaned daily.

5. *Put on Glove and Sleeve*—Dry your left hand and arm and dust with powder. Work the glove on gently, making sure that the finger tips fit tightly. Take a bar of soap in the left hand and a brush from the pail of water and lather the entire glove. Put several paper towels in your pocket for later use.

6. *Locate Cervix Through the Rectal Wall*—As the technician approaches the cow, he should speak to her and pet or rub her gently. The fingers of the gloved hand are gently inserted into the rectum with the hand being cupped to permit air to enter. If the hand is held in a cupped position for a short time, the cow will often clean her rectum. Occasionally it is necessary to remove the manure with the hand. Many experienced technicians inseminate cows without emptying the rectum. Locate the cervix by feeling downward through the rectal wall. This may be difficult at first, but it can be located readily after a few practice periods. The cervix should be pushed to the right and held gently between the thumb and fingers. Wipe the vulva with paper towel, making sure that the outer surface is clean and dry.

7. *Inseminating*—The kit should be placed so that the inseminating tube can be reached with the free hand. If the tube is held in the mouth, it is not necessary to place the kit in reaching distance. Insert the prepared inseminating tube 3 to 4 inches into the vagina with the syringe end of the tube tilted downward. After the tube passes over the elevated border and becomes more nearly free, it should be leveled and gently passed through the vagina until the cervix is reached. An inexperienced person will usually have difficulty in locating the mouth or opening of the cervix. This can be accomplished by holding the cervix between the second and third fingers and placing the thumb over the opening. Bring the inseminating tube forward until it touches the thumb, then remove the thumb and insert the tube. The cervix consists of several folds which make it difficult for the untrained person to pass a tube through the crooked canal. However, this can be accomplished by manipulating the cervix while gentle pressure is exerted on the tube. Probing or thrusting of the tube should be avoided. Deposit the semen near the mid-point of the cervix. Withdraw the tube and remove the other hand from the rectum.

Studies (19) at this station indicate that no increase in breed-
efficiency can be expected by depositing the semen beyond the
ldle of the cervix. When the inseminating tube is passed only
f way through the cervix, there is less chance of infection and in
e the cow is with calf, pregnancy is not likely to be interrupted.
wever, if an inseminating tube is passed through the cervix into
uterus of a pregnant cow, abortion will usually occur.

8. *Clean and Disinfect Glove*—Add disinfectant to the pail of
ter and wash glove with a bottle or scrub brush. Water from a
e may be used to rinse the glove before it is washed in the disin-
ting solution. Dry the glove thoroughly inside and out and powder
ith talcum. Fold the glove, pressing out all air possible, and place
a small box or wrap it in paper.

9. *Breeding Records*—Write breeding receipt and post farmer's
ividual herd record and the barn breeding record. Give the orig-
copy of the receipt to the owner and collect breeding fee, if any.

10. *Tagging the Cow*—If the cow is a grade, put a tag in her ear
ess she already has an ear tag or some other identification num-
such as a tattoo or neck chain. The tag should not be placed in
ear until at least five minutes after the insemination is completed
e any excitement will delay sperm movement and may reduce
chance of conception.

11. *Sanitary Precautions*—Place the used tube and syringe in the
y or speculum provided for this purpose. Put all used towels in a
sh can and leave the barn clean and orderly. When you are ready
eave, take your kit and pail of disinfectant to the car. Wash your
ts or overshoes thoroughly before emptying the disinfecting solu-
. This practice will lessen the chance of your spreading diseases
ween farms and will make a good impression on the dairyman.
e disinfectant should be emptied on the road or some other place
ere nothing is growing, as it may kill grass or other vegetation.

gnancy Determination

The ability to diagnose pregnancy is of prime importance for a
eding technician. Routine pregnancy determination is not the
hnician's job or responsibility. However, it is of utmost impor-
ce for him to examine cows that come in heat several months
er insemination or in cases where the breeding history is not
own. Records at this station indicate that approximately 5 per
t of the cows show signs of heat during pregnancy. Failure to re-
n to heat after breeding is a reliable indication of pregnancy in
lthy cows but may be misleading where breeding difficulties are
ing experienced. Results of a study at the Wisconsin station (5)
licate that about 80 per cent of the cows that do not come back in
at within 45 days after insemination are pregnant. More than 95
r cent of the cows that did not return to heat within 105 days

were found to be pregnant. Postestrus bleeding, which may be seen in about 80 per cent of the heifers and 60 per cent of the cows, does not indicate whether the animal conceived.

Wisnicky (31) described a method whereby pregnancy can be diagnosed as early as 35 days by palpating the amnionic vesicle in the horn of the uterus. The gloved hand, which has been lubricated with soap and water, is inserted into the rectum of the cow with the palm turned downward over the coiled horns of the uterus. After the uterus is located, it is picked up and held in the hollow of the hand. With the uterus in this position, the middle finger should lie over the place where the horns come together. The extended finger is pushed down between the horns until it can be hooked under the web that connects them. By lifting upward and backward, the horns can be uncoiled so that the entire length of each may be palpated between the thumb and fingers. The fetus cannot be detected in early pregnancy. It is in a sac-like structure surrounded by fluid which is called an amnionic vesicle. Palpation is made for the presence of this vesicle, which will appear as a small, turgid, slightly oblong, balloon-like structure. As the fingers are moved backward along the horn with gentle pressure being applied, the vesicle can be felt to slip away as an attempt is made to palpate it. The slippery feeling is unlike anything else in the horn and is a rather definite indication of pregnancy. Usually, the amnionic vesicle will be found in the horn on the same side as the ovary in which the corpus luteum is present. However, investigations made at this station indicate that the fetus is occasionally located in the horn on the opposite side from the ovary in which the corpus luteum is found. In the case of twins, there may be two vesicles in one horn or one in each horn.

At 35 days, the vesicle is balloon-like and is about 1¼ inches in diameter. The vesicle grows and elongates rapidly between the thirty-fifth and forty-ninth days. After the seventh week of pregnancy, the slipperiness disappears rapidly and the pressure within the vesicle decreases. The cervical seal forms some 30 to 40 days after pregnancy is initiated. By 60 days, the fetus is some 2¾ inches long and is surrounded by a large amount of fluid, with the pregnant horn being almost twice its normal size. The fetal membranes may be felt to make sure that the uterine enlargement is due to pregnancy rather than metritis or tumors. This test consists of picking up the uterus and its fetal membranes, first allowing the fetal membranes to slip between the thumb and index finger and then the uterine wall. If only one tissue is felt to slip through the fingers, it will be the uterine wall, indicating that the fetal sac is not present.

According to Fincher (12), the cotyledons can be felt and the fetus can be palpated as early as the third or fourth month of pregnancy. After the fifth or sixth month, the fetus drops forward and downward and may be beyond reach. However, at this stage the

middle uterine arteries within the broad ligaments just back of the ovaries, alongside the cervix and base of the uterine horns are of extreme value in diagnosing pregnancy. The arteries will be ¼ to ½ inch in diameter and the blood can be felt to "swish" through the fingers. It is not a sharply defined throb, as in the arteries of a non-pregnant cow or during the early stages of pregnancy.

"Bumping" or palpating the calf through the flank of the cow is usually possible after the seventh or eighth month of pregnancy (25). By pressing the hand strongly and several times in succession against the right flank, about eight inches in front of the stifle and slightly below it, the movement of the fetus can usually be felt. Since this method cannot be used until the latter part of pregnancy, it is of little or no value in artificial insemination or in an efficient dairy operation.

Early pregnancy diagnosis is of prime importance. Pregnancy diagnosis can be learned only by practice and experience. The technician or herdsman can educate his finger tips by examining cows at every opportunity and relating his findings to breeding records.

The age of premature or aborted calves may be estimated from the following information reported by the Minnesota station (30). At four months of age pigmentation of the hair follicles may be seen, and the fetus is about 10 inches long and weighs about 1¾ pounds. Hair appears around the eyes at five months and the fetus weighs about six pounds. The body of the calf is covered with hair at eight months.

Fertility of Cattle

Fertility in the cow may be defined as the ability to produce fertilizable ova or eggs and to provide a tubular and uterine environment satisfactory for the processes of fertilization, implantation, embryonic and fetal development, and parturition. In the bull, fertility may be defined as the ability to produce large numbers of spermatozoa which are capable of fertilizing eggs and initiating and maintaining the processes of cell division necesary to the development of the embryo. It further implies that the bull must be physically capable of depositing spermatozoa in the female reproductive tract or in the artificial vagina when he is used in artificial breeding. Thus, it can be readily seen that fertility depends upon a series of complicated physiological processes in both sexes and that it is possible for many things to happen between the time a cow is bred or inseminated and the birth of a fully developed normal calf. However, before discussing the factors which affect fertility, the different measures of fertility should be considered.

Measures of Fertility

There are many measures of fertility. It can be measured in the cow in terms of the number of services or breedings required per

conception or per calf. Dairy cows require an average of about 1.6 services per conception. Other measures of fertility are calving interval, average months per calf during the reproductive life of a cow, and the number of calves per 100 females bred. It is highly desirable for a cow to produce a calf every 12 months. For range beef cattle, calf crops average from 50 to 70 per cent. Herds of well-fed and well-managed beef cattle will generally approach 90 per cent calf crops. It should be appreciated that any measure of fertility for the individual cow is subject to a great amount of error and variation.

For bulls used in artificial breeding, fertility is usually expressed as the percentage of cows not returning for service within an arbitrarily established period of from 30 to 180 days, the percentage of 60- to 90-day non-returns to first services being the most commonly used measure. It has been found that the percentage of 60- to 90-day non-returns to first services closely approximates actual pregnancy, having an error of only about 5 or 6 per cent. Fertility levels of individual bulls calculated on this basis vary from 30 to 85 per cent, averaging about 70 per cent. Since artificial breeding provides an opportunity to breed one bull to many cows, the level of fertility of an individual bull can be determined accurately.

Factors Influencing Fertility

Since neither the nature nor the relative importance of many of the factors influencing fertility of cattle in Louisiana was known, a series of studies was begun in 1951. In these studies, the factors were grouped into two major categories; namely, heredity and environment. It is very important to know what fraction of the differences in the fertility among cows is due to heredity and what part is due to environment before wise decisions can be made in any selecting and breeding program for improving fertility.

Heredity—Analyses of the breeding and calving records of the LSU Holstein herd for the period 1931 through 1946 revealed that there were 370 daughters of 15 sires that required an average of 1.71 services per conception, ranging from a low of 1.13 to a 2.23 services per conception. Thus, the daughters of certain sires were better breeders or had higher fertility than the daughters of other sires, indicating some hereditary basis for fertility. Statistical analyses of the data, however, showed that services per conception in these daughters were only 10.6 per cent heritable with a repeatability of 9.8 per cent. In other words, 89.4 per cent of the differences in the fertility of the cows were due to environmental factors and only 10.6 per cent of the differences were due to heredity. The estimate of 10.6 per cent for the heritability of services per conception agrees very closely with the estimates reported by other investigators.

Under present conditions, therefore, it seems that it would hardly pay to select for fertility upon the grounds of heredity using the measures of fertility now available, when there are more strongly heritable factors, such as those for milk, fat, and type, that might suffer in the selection. The greatest improvement in fertility could be made through working with some of the environmental factors which affect fertility. However, it should be emphasized that these results do not mean that there is no heritable tendency for low fertility or sterility, but that heredity accounts for only a small part of the over-all infertility problem. There have been two different genes associated with infertility, but apparently the frequency of these genes is very low in most herds and in the over-all cattle population.

Another aspect of this investigation which should be discussed briefly is the repeatability of 9.7 per cent for services per conception. Repeatability may be defined as the similarity of successive records of the same individual. An estimate of repeatability tells us how much we can trust a past record or records of an animal as an indication of its future performance. The estimate of 9.7 per cent is very low. Therefore, the number of services required per conception for a cow this year is a rather poor indication of how many services she will require next year. These results also are contradictory to the common belief: "Once a hard breeder, always a hard breeder." A cow might require six services for conception this year and settle on the first service next year. One should not be too hasty in culling a cow on the basis of her fertility during a single year. However, it is realized one must weigh the inherent producing ability of the cow in question against the economy of keeping her dry for any extended period of time.

Environment—Since heredity seemed to play such a small part in over-all fertility of dairy cattle, investigations were initiated to obtain information on the environmental factors affecting fertility of dairy cows in Louisiana. These investigations were done in the Louisiana State University dairy herd and in 84 other herds in different sections of Louisiana. A total of 383 "problem" breeding cows were examined. The environmental factors considered were as follows: time of postpartum service, timing of service during the heat period, age of cow, seasonal effects, diseases, physiological disorders, and general feeding and management practices.

Time of Postpartum Service—Since previous studies had indicated that the highest fertility was obtained when cows were bred 60 to 90 days postpartum (after calving), this practice was recommended from the outset (1947) in the Louisiana Artificial Breeding Program. These recommendations were based not only on the fertility results but also on the fact that certain changes must take

place in the uterus of the cow before conception can occur readily. The fluids present in the uterus after calving must be expelled or be reabsorbed into the blood stream of the cow, and the uterus must return to its normal size and healthy condition. These changes are not completed until 45 to 60 days after calving. In spite of the recommendation to wait 60 days after calving to breed cows, it was found that 35 per cent of the 85 farmers were breeding their cows less than 50 days after calving. Although the fertility results have not been completely tabulated on these herds, they were, no doubt, similar to those shown in Table 1 for the LSU herd.

TABLE 1.—The relationship between time bred after calving and services per conception in the LSU Holstein herd (1931-1946)

	Time bred after calving (days)				
	1-40	41-60	61-90	91 or more	Total
No. of services	78	153	311	459	1,001
No. of calves	33	85	180	267	565
No. of services per calf	2.36	1.80	1.73	1.72	1.77

It will be noted in Table 1 that more services were required per calf when cows were bred less than 60 days after calving, particularly when cows were bred within 40 days after calving.

The question often arises as to whether a dairyman is justified in breeding his cows less than 60 days after calving in an effort to have them calve at some desired time. The time of freshening or calving is very important for most Louisiana dairymen, since their base milk pricing period is from September 1 to January 1. Granting that they sacrifice some in fertility by breeding cows less than 60 days after calving, as shown in Table 1, the question then is whether or not they gain any time following such a practice. This question is answered by the results adapted from Trimberger's report (27).

TABLE 2.—Conception rate at various intervals after calving and days from calving to conception

Interval from calving to first service	Per cent conception	Days from calving to conception
50 days or less	31	100
51-60 days	67	75
61-90 days	70	94
More than 90 days	76	130

These results definitely show that when cows are bred within 5 days or less following calving, more days are required for conception than when cows are bred 51 to 90 days after calving. In other words, time is lost, not gained, by breeding cows too early. The dairyman

should wait at least 50 days after calving, preferably 60 to 90 days, to breed his cows in order to obtain the highest fertility and save the most time.

Timing of Service During the Heat Period—It has been known for several years that the highest fertility is obtained when cows are bred from the middle to the end of the heat period. In the temperate regions of the world, it has been found that the heat period usually ranges from 2½ to 28 hours. In fact, it has been reported that 93 per cent of the cows will fall within the range of 13 to 27 hours. However, results on 129 cows and heifers of the Holstein and Jersey breeds in the LSU herd show an average of 12 hours for the duration of heat, with a range of 3 to 36 hours. These results indicate that the average duration of heat in Louisiana, which is a subtropical area, is from 5 to 6 hours shorter than that reported in the temperate regions.

Table 3 gives a practical guide for inseminators. This guide takes into consideration the relationship between the time of service and the time of ovulation, or release of the ripe egg, and the length of time the spermatozoa and egg will remain fertile in the cow's reproductive tract.

In order to put the information in Table 3 to its greatest use, the dairyman or beef cattle producer must check cows for heat at least twice daily, preferably three times a day, and report to the breeding technician the exact time the cow was first observed in heat. Three times a day is recommended, not only to obtain the highest fertility but also because studies in Louisiana show that many cows are missed by twice daily checks. This results in unnecessary delays in getting many cows in calf and the loss of money if the cow does not freshen at the proper time. Another point which should be emphasized is that some cows have "silent" heats or show very few signs of heat. Such cows require very careful observation by the herdsman. The herdsman will find that a heat expectancy chart is very useful in making these thrice daily observations for heat. Most cows have estrus cycles of 16 to 24 days, averaging about 21 days. Thus, after a cow has had two or more heat periods, one can predict quite accurately when she will return to heat.

TABLE 3.— Time to breed cattle artificially for best results

Heat first observed	Best time to breed	Too late for good results
Morning (before 9 a.m.)	The same day (afternoon)	Next day
Forenoon (9 a.m. to 12 noon)	Late the same day or early next day	After 10 a.m. next day
Afternoon and early evening (night milking)	Next morning (forenoon)	After 2 p.m. next day

TABLE 4.—The relationship between age of cow and services per calf in the LSU Holstein herd (1931-1946)

Number of calf	Number of cows	Number of services per calf
First calf (heifers)	370	1.61
Second calf	249	1.76
Third calf	186	1.82
Fourth calf	131	1.73

Age of Cow—Many workers have presented evidence that the fertility of dairy cows varies with age. Also, it appears that many Louisiana dairymen and breeding technicians are of the opinion that heifers are more difficult to settle in calf than are mature cows. Table 4 presents results on the relationship between age and the number of services required per calf in the LSU Holstein herd. Statistical analysis of these data revealed no significance among these different age groups. Therefore, it appears that virgin heifers will conceive just as readily as older cows.

Seasonal Effects—From the outset of the artificial breeding program in Louisiana, it has been observed that the quality and fertility of semen of bulls are affected by the high temperatures and humidities during the summer months. The proportion of abnormal

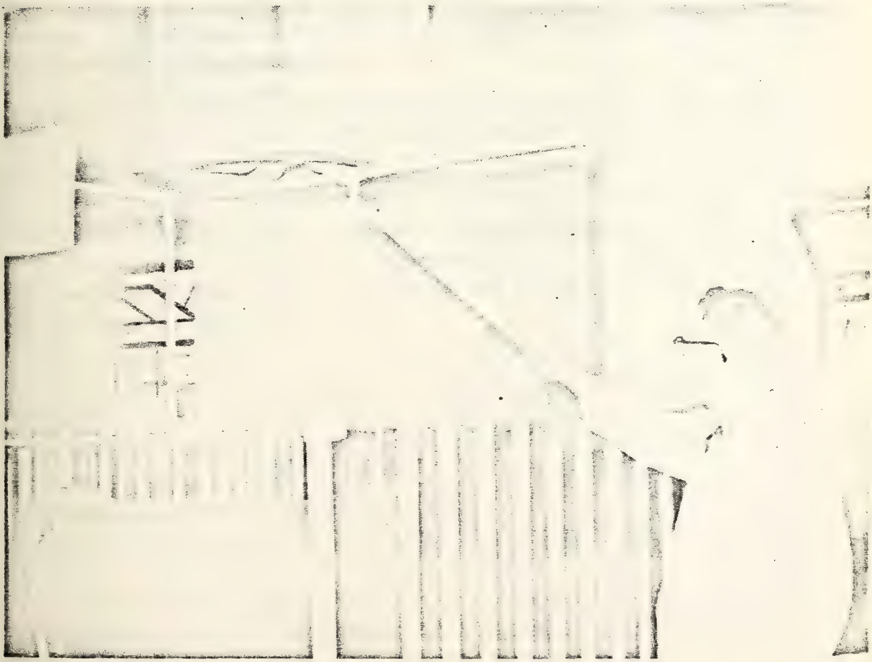


FIG. 16.—View of LSU barn showing fan and sprinkler used for coolin bulls during summer months.

spermatozoa increases and initial motility of the spermatozoa decreases in the summer and early fall months, resulting in many ejaculates being unfit for artificial insemination purposes. Studies (24) have been conducted for the past five years on artificial cooling of bulls in an effort to improve this situation. Some beneficial results from cooling have been obtained, but these investigations are still in progress and no definite statements can be made.

That the fertility of cattle varies with seasons of the year in Louisiana has been observed for some time now. In artificial breeding (19), the fertility has been the lowest during the summer and fall and the highest during the spring. Table 5 gives the results in the LSU herd.

TABLE 5.—Seasonal variation in fertility in the LSU Holstein herd (1931-1946)

Seasons	Number of first services	Per cent 60-90 day non-returns
Spring (March, April, May)	428	72.7
Winter (December, January, February)	712	69.9
Fall (September, October, November)	421	66.0
Summer (June, July, August)	105	51.4

Natural service was practiced during this time. Although results in artificial breeding have not been as marked as those shown in Table 5, they have shown a similar trend. Therefore, it definitely appears that climate has some effect on the fertility of cattle. This effect is now under investigation.

Diseases—It is generally believed that any disease which affects the health of a cow will also affect her fertility. However, certain diseases have rather specific effects on reproductive efficiency. Among these diseases are brucellosis, or Bang's disease, vibriosis, trichomoniasis, and granular vaginitis. These diseases are often referred to as genital or venereal diseases of cattle. The organisms causing the first three of these diseases are harbored in the uterus and can affect fertility materially.

During recent years, the incidence of brucellosis has ranged from 6 to 14 per cent of all cattle tested by the state and federal veterinarians in Louisiana. However, it was found in only 2 per cent of the "problem" cows in the 85 herds mentioned previously. Many dairymen are of the opinion that abortion is the primary effect of Bang's disease. It must be emphasized, however, that this disease is not the only cause of abortion in cattle, nor do all cows having this disease abort. On the average, Bang's positive cows are more difficult to settle in calf. Information on brucellosis control and eradication programs is available from county agents and veterinarians.

Vibriosis, or *Vibrio fetus,* is a genital disease which causes re-

peat breeding, delayed breeding, sterility, and abortion. Abortions are usually earlier than those in Bang's disease animals. As is the case with Bang's disease, not all infected cows abort. Since testing programs are not highly accurate, the incidence of vibriosis in Louisiana is unknown. However, the symptoms of repeat breeding and abortion in many herds indicate that this disease is a factor in the state. Five per cent of the "problem" cows tested by the cervicovaginal mucus agglutination test in 85 herds gave a positive reaction. Also, the *Vibrio fetus* organism has been isolated from aborted calves. This is proof that the disease is in Louisiana cattle, but it does not give any conclusive evidence as to its prevalence. When this disease is suspected in a herd, the farmer should consult his veterinarian immediately, since it can mean the difference between a very poor calf crop and a satisfactory level of fertility.

Only a very limited number of cases of trichomoniasis have been diagnosed in Louisiana. In fact, only two cases were found in the 85 herds studied from 1953 to 1956. However, dairymen and veterinarians should be on the lookout for this disease, since it can cause low fertility and abortions.

Granular vaginitis, which is a venereal disease that primarily affects the vulva and vagina of the cow, is quite prevalent in Louisiana. It was found in 26.4 per cent of the 383 "problem" cows examined in the 85 herds. It should be emphasized, however, that it was just as prevalent in pregnant as in non-pregnant cows. This raises some questions as to the effect of granular vaginitis on fertility. Most authorities agree now that, unless the infection is severe, it has very little or no effect on fertility.

Several diseases, such as leptospirosis and anaplasmosis, affect the general health of an animal and can affect fertility also. In fact, the high fever which often accompanies leptospirosis, in particular, has been observed to cause many abortions, retained afterbirths, and repeat breedings in some of the herds studied. The incidence of leptospirosis was found to be 7 per cent in the herds studied.

Physiological Disorders—The most common physiological disorders affecting fertility observed in Louisiana cattle have been anestrus and cystic ovarian follicles. In the 85 herds studied, 8.2 per cent of the "problem" cows were classified as being anestrus. Anestrus cows were those that had not been in heat for an extended period after calving, heifers that showed no heats, and bred cows that were found to be open when examined for pregnancy. Two primary causes of anestrus were found to be persistent corpus luteum, or "yellow body," and inactive ovaries. Cystic ovarian follicles were found in 5.3 per cent of the "problem" cows. Most of these cows came into heat at very frequent intervals, less than 15-day cycles, while some were "chronic bullers." The chronic bullers remain in

heat almost continuously. Fertility in such instances is very low. Each of these difficulties requires veterinary attention.

Feeding and Management—Feeding practices can and do affect fertility in some cases. However, it should be emphasized that when the feeding was anywhere near adequate, no relationship was found between feeding practices and fertility in the herds studied. Under these feeding conditions, adequate quantities of vitamin A or provitamin A (carotene) and phosphorus were being fed. Feeding supplementary vitamin E in the form of wheat germ oil and similar products has shown no beneficial effects on fertility. When cattle are fed a balanced grain ration with plenty of green forages in the form of pasture, hay, silage, and soilage, along with the necessary minerals either in the grain mixture or as a supplement, it would appear that adequate nutrients for high fertility are obtained.

Several management practices that are related to the fertility of cattle have already been mentioned in connection with time to breed cows and diseases. In addition to these, breeding methods, replacements, and herd sanitation should be discussed briefly. Studies in Louisiana show that 41.3 per cent of the dairymen using artificial breeding use a combination of bulls in natural service and artificial insemination. If there are any genital diseases present in these herds, this is an excellent method of spreading them. It has been established definitely that a bull can spread brucellosis, vibriosis, trichomoniasis, and granular vaginitis through the physical contacts he makes in natural mating or through his infected semen. On the other hand, when artificial insemination is done properly, the bull is removed as a spreader of these diseases.

The Louisiana studies also show that 70 per cent of the dairymen buy replacements at least every two years. Thirty per cent of those buying replacements do not have the cattle tested for diseases that affect fertility. This practice can lead to many breeding difficulties.

The primary factor in herd sanitation is care of the cow at and immediately after calving. One should make sure that the cow is properly cared for and that she does not retain the afterbirth. Abnormal discharges of blood and pus which persist after calving should be observed and called to the attention of the veterinarian and breeding technician.

The more important management faults found in Louisiana agree with those reported by Asdell for New York (4). They are summarized as follows:

1. Failure to detect signs of heat and to breed at the most favorable time.
2. Breeding back too soon after a cow has calved. Sixty days is soon enough if the cow has cleaned properly. Earlier breeding has a lower percentage of success.

3. Failure to call in the veterinarian at the first sign of trouble. These signs of trouble are as follows: (a) absence of heat periods, (b) presence of any unnatural discharges, (c) heat periods of fewer than 15 days or continuous heat, (d) heat periods irregular or at intervals of more than 28 days, (e) cows or heifers receiving three or more services without conceiving, (f) abortions at any time, and (g) retained placenta.
4. Changing bulls when a cow does not conceive to a first or second service or using both natural and artificial service.
5. Purchasing replacements without health records.

Although little is known about many of the factors which affect fertility of cattle, fertility can be improved considerably by putting into practice what is already known. This requires proper feeding and management by the dairyman, cooperation between the breeding technician and dairyman, good breeding technicians, veterinary services when needed, patience, and highly fertile bulls in the stud.

Selecting Sires for Use in Artificial Insemination

The primary objective of artificial insemination is herd improvement. Good bulls are where you find them, and the good ones will transmit high production and desirable type when placed in artificial service regardless of the line of breeding or name. "A rose by any other name would smell the same." Genetic ability is the important factor. Everyone likes a bull that looks good, but it must be remembered that there is practically no correlation between type of a bull and production of his daughters. Likewise, there is very little correlation between the type of a bull and the type of his daughters. It is much more important to find out how his sisters and daughters look and produce. A "Fancy Pedigree" is often overemphasized. Pedigrees are very important but may also be misleading. Variation in environmental conditions on farms makes pedigree evaluation quite difficult. Production alone is not the answer. The dairyman wants large straight cows with good feet and legs and well-attached udders. He is not interested in a cow that milks well for one or two lactations, then has to be culled because the udder goes to pieces.

Proved Sires

There are many definitions of a proved sire. However, there are two different types of proof. "Natural" proof is based on 10 or m unselected daughter-dam comparisons. The daughters are sired b natural mating and are usually located in one or two herds. "A B proof is based on 40 or more unselected artificially sired daught which are located in many different herds. "A B" proof is usu lower than "natural" proof since the records are made under av age farm conditions which may include all levels of feeding an

management. However, "A B" proof is a better estimate of a bull's transmitting ability.

Proved sires vary a great deal in their genetic ability. The integrity of the owner must not be overlooked. It is important to determine what portion of the daughter's production is due to environment and how much is due to the genetic ability of the bull. One must also find out whether all tested daughters are included in the proof, or if it is based on selected records. The best "natural" proof is where the daughters and their dams are in the same herd and have had the same treatment. Most authorities agree that the level of production is determined largely by feed and management, with breeding accounting for only about 25 per cent of the production. Thus, a bull whose daughters average 8,000 pounds of milk and 400 pounds of fat under ordinary farm conditions may be equal or superior to a bull whose daughters have a much higher level of production under a more nearly ideal environment.

Research workers in New York compared "natural" proof with "A B" proof on 50 Holstein sires. The sires were ranked in four groups according to the level of their "natural" proof. The results are shown in Table 6.

TABLE 6.—Comparison of "natural" proof with "A B" proof

Ranking of sires	Average of natural daughters	Average of AB daughters
	(lbs. fat)	(lbs. fat)
Top 25%	499	435
2nd 25%	472	440
3rd 25%	460	419
4th 25%	450	419
Over-all average	470	428

This table emphasizes the effects of different kinds of environment. "A B" daughters are usually in commercial herds with all types of conditions, while "natural" proofs are more often made in superior environments.

Selected Young Sires

Do sires with "natural" proof have better "A B" daughters than "selected" young bulls? With this question in mind, Pennsylvania workers made a comparison between the two groups and found essentially no difference in production or type. The results are shown in Table 7. This study indicates that "carefully selected" young bulls are just as reliable as bulls with "natural" proof.

Some of the points to be considered in selecting young bulls are:

1. The sire and grandsires should be proved for desirable type and high production. ("A B" proof is highly desirable.)
2. The dam and granddam should have several good records (un-

TABLE 7.—Comparison of "A B" daughters of "natural" proved sires with "A B" daughters of carefully selected young bulls

Breed	No. of bulls	Natural daughters fat. av.	Natural daughters diff.	"A B" daughters fat av.
	PROVED SIRES			
Holstein	22	474	+56	421
Guernsey	7	470	+35	367
Jersey	6	390	+52	422
	YOUNG SIRES			
Holstein	13			422
Guernsey	18			377
Jersey	15			413

selected). It is also desirable for them to have three or more tested sons or daughters reasonably good in type.

3. Much can be learned about a young bull by studying his half-sisters and half-brothers.
4. Size is an inherited trait and is thought to be a big factor in relation to production.
5. The young bull should have reasonably good body conformation.
6. Last but not least, the herd from which the sire is selected should be noted for continuous high production and good type. The pedigree of a "carefully selected" young bull is shown in Figure 17. His sire and grandsires are examples of desirably proved bulls.

Health of Bulls

Bulls are tested for all known reproductive diseases, including brucellosis, tuberculosis, vibriosis, trichomoniasis, and leptospirosis before they are placed in service and at regular intervals thereafter. As an added precaution, the health of the herd from which the bulls are purchased is investigated. Tests are also made to determine semen quality and potential fertility of each bull.

Records and Reports Used in Artificial Insemination

Adequate records and reports are essential for the successful development of an artificial insemination program. Records kept by artificial insemination organizations may be used for many purposes. First and foremost, complete and accurate financial and breeding records are necesary for the routine operation of the association. It would be impossible to operate efficiently without up-to-date breeding efficiency records for technicians and bulls. The reports enable the management to curtail or discontinue service from bulls that do not have a satisfactory level of fertility. The relative efficiency of each technician is also indicated by these reports. This gives the field supervisors an opportunity to spend more time

B D I PABEMPGOV ALGY—1281300
Born: 1-30-56
Bred by: Dairy Research Branch,
U. S. D. A.,
Beltsville, Maryland
All records 2 x 305 M.E.

PABST RAMBLER WALKER—975138
—"VG"
Silver Medal Production & AI
Proved Sire.
1,359 AI Daus. av. 13,340M 3.6% 478F
61 Daus. av. 15,063M 3.7% 553F
61 Dams av. 14,125M 3.7% 526F
+938M +27F
114 Cl. Daus. av. 80.0% 100.7 BAA%

PABST RAMBLER 916876
4 daus. av. 18,545M 3.5% 646F
78 cl. offspring: 4E, 24 VG, 38 GP, 13 G,
1F. SON OF: Pabst Roamer "EX" Gold
Medal Sire.

PESTER INEZ DEAN ORMSBY—
2054580
2 rec. av. 13,590M 3.6% 493F

B D I EMPGOLIN ANNETTE—3507143
3 rec. av. 19,787M 3.7% 741F
Best rec. 22,236M 3.7% 812F
19,336M 3.7% 706F 3-3 305 2x (actual)
National record for milk in this class.

S J Ç VALLEY EMPEROR STAR—
857269—"VG"
Silver Medal Production & AI Proved
Sire
52 daus. 13,614M 3.8% 519F
52 dams 12,828M 3.7% 478F
+786M +.1% +41F
862 AB daus. av. 11,486M 3.8% 433F

B D I GENLINO ANNETTE—2817080
2 rec. av. 18,048M 3.9% 711F
Best rec. 18,987M 3.9% 733F

FIG. 17.—Pedigree of an outstanding young sire.

in the areas where their assistance is needed most. Monthly reports that include the number of cows inseminated and the breeding efficiency for each local unit are published. This gives the technicians and officials of the locals an opportunity to compare their results with those of other areas.

Secondly, the Purebred Dairy Cattle Association has established certain requirements governing artificial insemination of purebred dairy cattle. Some of the more important requirements are as follows: (1) The bull stud must sign a contract agreeing to carry out all rules and regulations of the PDCA, and the manager and all technicians must be certified. (2) All bulls must be blood typed before being placed in service. (3) Permanent records of semen collections and shipments must be kept. (4) All technicians must use the PDCA approved breeding receipts. (5) Complete individual herd breeding records, including carbon copies of breeding receipts, must be retained for a period of at least three years. (6) Tubes of semen must be accurately labeled at all times. (For more detailed information including "Instructions to the Inseminators," see the official PDCA regulations.)

Thirdly, artificial insemination records and reports furnish valuable information to agricultural extension agents, research workers, teachers, and writers. Records kept by the local officers and technicians include the following: (1) treasurer's monthly financial report, (2) inseminator's daily record and cash receipts, (3) indi-

FIG. 18.—A view of the record room at the Dairy Improvement Center. The name of the cow, date of insemination, bull used, and other information is transferred from the breeding receipts to machine cards for analysis. Complete and accurate information is readily available for research, routine operation, and monthly and annual reports.

vidual farmer's ledger, (4) individual farmer's herd record, (5) barn breeding records, (6) breeding receipts, and (7) membership agreements. Copies of the breeding receipts, semi-monthly summary sheets, copies of the agreements for new members, and treasurer's reports are forwarded to the central office at regularly designated intervals.

Complete and accurate records are necessary for the efficient operation of an artificial insemination organization. The technician is a very important "spoke in the wheel" of a record-keeping system. He must be honest, thorough and efficient in his techniques of inseminating as well as in his record keeping. There is no place for shortcuts or putting off until tomorrow what should be done today in either of these important phases of his work.

Summary of Important Facts Relating to Artificial Insemination

1. The first artificial breeding association in the United States was organized in 1938 at Clinton, New Jersey, with 102 members and 1,050 cows enrolled.

2. By January 1, 1960, artificial insemination was being used in every state in the Union, with a total of 6,932,294 cows being inseminated in 946,000 herds during 1959.

3. Artificial insemination of dairy cattle was started on a statewide basis in Louisiana on October 15, 1947, with the program being administered jointly by the Louisiana Artificial Breeding Cooperative, Inc., and the LSU College of Agriculture.

4. By January 1, 1960, there were 42 local circuits employing 45 breeding technicians and more than 51,000 cows being inseminated annually in the state.

5. In artificial insemination, the usefulness of outstanding sires may be increased manifold. On the average, bulls used in organized breeding associations are bred to more than 2,800 cows annually.

6. A general knowledge of the structure and functions of the reproductive organs of the male and female is essential in order to master the techniques used in artificial insemination.

7. Use of the artificial vagina has been found to be the most practical and satisfactory method of collecting semen from the bull.

8. Good quality semen from highly fertile bulls is one of the primary requirements for success in artificial insemination.

9. No single test has been devised that will accurately measure semen quality and reliably predict its potential fertility. However, the following combination of tests and minimum standards are recommended for semen evaluation: (1) initial progressive motility of at least 50 per cent, (2) a concentration of at least 500,000,000 sperm per ml., and (3) a modified methylene blue reduction time of

nine minutes or less. Previous breeding records are also a valuable aid in predicting the fertility of a bull.

10. Any delay in extending semen and starting the cooling process will cause a decrease in quality and an increase in bacterial growth.

11. For best results, liquid semen should be cooled gradually and stored at 40° F.

12. Egg yolk-citrate and heated milk are the most widely used fluids for extending semen.

13. When penicillin and streptomycin are added to extended semen, they not only increase fertility but control bacterial growth, improve livability of the spermatozoa, and act as metabolic depressors.

14. High quality semen can be extended at a ratio of 1:100 or to contain 7,000,000,000 live sperm per ml. without any decline in fertility.

15. The desired temperature of 38° to 40° can be maintained in shipment provided the semen is properly packaged.

16. Properly prepared semen can be frozen and stored at —79° C. (—110° F.) or colder for an indefinite period with little or no decline in fertility.

17. The deep cervical or intra-uterine method of insemination has been found to be the most satisfactory technique.

18. One ml. of extended semen deposited in the middle of the cervix has been found to give optimum results. When the insemination tube is passed halfway through the cervix, there is less chance of infection, and in case the cow is with calf, pregnancy is not likely to be interrupted.

19. Pregnancy in cattle can be accurately diagnosed as early as 35 days by an experienced person.

20. Fertility was found to be only 10.6 per cent heritable, thus indicating that most breeding difficulties are environmental in nature.

21. The cow should have a sexual rest of at least 50 days after calving. Time is actually lost, not gained, by breeding cows too soon.

22. Cows should be checked for heat at least twice and preferably three times a day.

23. For best results, cows should be inseminated between the middle and the end of the heat period.

24. Age of the animal is not an important factor affecting fertility. When the non-breeders are disregarded, heifers conceive just as readily as older cows.

25. Season is an important factor affecting fertility of cattle. The level of fertility in Louisiana is highest in the spring and lowest in the summer, with fall and winter being intermediate. Bulls show a marked decline in semen quality during the late summer and early

fall. Some beneficial results have been observed when bulls were cooled by artificial means.

26. The most important genital diseases affecting the fertility of Louisiana cattle are brucellosis, vibriosis, trichomoniasis, and vaginitis.

27. The two most common physiological disorders affecting fertility were found to be anestrus and cystic ovarian follicles.

28. Feeding practices do affect fertility in isolated cases. However, where nutrition was anywhere near adequate for growth and production, it was not a factor in reproduction.

29. Artificially sired daughters of "carefully selected" young bulls are equal in production and in type to artificially sired daughters of sires selected on the basis of "natural" proof.

30. "A B" proof, based on artificially sired daughters located in many herds, is the most reliable estimate of a bull's transmitting ability.

31. Complete and accurate records are necessary for the successful operation of an artificial insemination program.

32. Much of the success achieved in artificial insemination can be attributed to research. Likewise, the future of this program is dependent upon the development of new and improved techniques.

References

1. Almquist, J. O. A Comparison of Penicillin, Streptomycin and Sulfanilamide for Improving the Fertilty of Relatively Infertile Bulls. J. Dairy Sci., 32:722. 1949.
2. Almquist, J. O., Prince, P. W., and Reid, J. J. Bacteriological Studies of Bovine Semen. I. Number of Bacteria and their Relation to Fertility. J. Dairy Sci., 32:543. 1949.
3. Anderson, H. W., and Seath, D. M. Effect of Delay in Diluting and Cooling on Keeping Quality of Bull Semen. J. Dairy Sci., 31:551. 1948.
4. Asdell, S. A. Cattle Fertility and Sterility. Little, Brown and Co., Boston and Toronto. 1955.
5. Barrett, G. R., Casida, L. E., and Lloyd, C. A. Measuring Breeding Efficiency by Pregnancy Examinations and by Non-returns. J. Dairy Sci., 31:682. 1948.
6. Branton, C., D'Arensbourg, G., and Johnston, J. E. Semen Production, Fructose Content of Semen and Fertility of Dairy Bulls as Related to Sexual Excitement. J. Dairy Sci., 35:801. 1952.
7. Branton, Cecil, James, C. B., Patrick, T. E., and Newsom, M. H. The Relationship Between Certain Semen Quality Tests and Fertility and the Interrelationship of These Tests. J. Dairy Sci., 34:310. 1951.

8. Branton, Cecil, Kellgren, H. C., and Patrick, T. E. The Importance of Numbers of Spermatozoa in Relation to Semen Quality and Fertility of Dairy Bulls. J. Dairy Sci., 34:1301. 1953.
9. Branton, Cecil, Patrick, T. E., Simon, Denis E., Jr., and Newsom, M. H. Streptomycin and Penicillin Increase Fertility of Bull Semen. Research in Agriculture. Annual Report, Agricultural Experiment Station, Louisiana State Universty and A. and M. College. 58. 1949-50.
10. Bratton, R. W., Foote, R. H., and Henderson, C. R. The Relationship Between Fertility and the Number of Spermatozoa Inseminated. J. Dairy Sci., 37:1353. 1954.
11. Dzink, P. J., Graham, E. F., and Petersen, W. E. The Technique of Electro-ejaculation and Its Use in Dairy Bulls. J. Dairy Sci., 37:1035. 1954.
12. Fincher, M. G. Some Phases of Sterility in Cattle. Cornell Vet. 33, 257. 1943.
13. Herman, H. A. and Madden, F. W. The Artificial Insemination of Dairy Cattle; A Handbook and Laboratory Manual. Lucas Brothers, Columbia, Missouri. 1953.
14. Herman, H. A., and Ragsdale, A. C. Artificial Insemination of Dairy Cows. Mo. Agr. Sta. Bul. 540. 9. 1950.
15. Kellgren, H C., Patrick, T. E., Johnston, J. E., Branton, Cecil, and D'Arensbourg, G. F. Field Trial with Bovine Spermatozoa Frozen and Stored at —79° C. (Annual Report of Agricultural Experiment Station, Louisiana State University. 1954-55.)
16. Mayer, D. T., and Lasley, J. F. The Factor in Egg Yolk Affecting the Resistance Storage Potentialities and Fertilizing Capacity of Mammalian Spermatozoa. J. Animal Sci., 4:261. 1945.
17. Mixner, John P. Processing, Storing and Shipping Frozen Bull Semen. N. J. Agr. Expt. Sta. Bul. 573. 1955.
18. Patrick, T. E., Branton, Cecil, and Anderson, H. W. Factors Affecting Efficiency of Reproduction in Dairy Cattle Serviced by Artificial Insemination. Research in Agriculture, Annual Report, Agricultural Experiment Station, Louisiana State University and A. and M. College. 1951-52.
19. Patrick, T. E., and Herman, H. A. Study of Some Factors Affecting Efficiency of Reproduction in Dairy Cattle Serviced by Artificial Insemination. Mo. Res. Bul. 526: 1-42. 1953.
20. Perry, E. J. The Artificial Insemination of Farm Animals: Rutgers University Press, New Brunswick, N.J. 2nd Ed. 65. 1952.
21. Phillips, Paul H., and Lardy, Henry A. A Yolk-Buffer Pabulum for the Preservation of Bull Semen. J. Dairy Sci., 23:390. 1940.
22. Salisbury, G. W. Fertility of Semen Diluted 1:100. J. Dairy Sci., 29:695. 1946.

23. SALISBURY, G. W., FULLER, H. K., AND WILLETT, E. L. Preservation of Bovine Spermatozoa in Yolk-Citrate Diluent and Field Results from Its Use. J. Dairy Sci., 24:905. 1941.

24. SMITH, J. W., PATRICK, T. E., JOHNSTON, J. E., D'ARENSBOURG, G. F., BRANTON, CECIL, AND KELLGREN, H. C. The Effect of Air Movement, Air Movement Plus Sprinkling and Air Conditioning on Semen Production and Physiological Responses of Dairy Bulls Under Southern Conditions. Annual Report of Agricultural Experiment Station, Louisiana State University. 1954-55.

25. STAMM, G. W. Artificial Breeding and Livestock Improvement. 1st Ed. Published Windsor Press, New York, N.Y. 89. 1954.

26. THACKER, D. L., AND ALMQUIST, J. O. Milk and Milk Products as Diluters for Bovine Semen. J. Animal Sci., 10:1082. 1951.

27. TRIMBERGER, G. W. Conception Rates in Dairy Cattle from Services at Various Intervals After Parturition. J. Dairy Sci., 37:1042. 1954.

28. WEETH, H. J., AND HERMAN, H. A. Comparative Efficiency of Intercervical and Intrauterine Methods of Insemination. J. Dairy Sci., 34:195. 1951.

29. WILLETT, E. L., AND SALISBURY, G. W. The Effect of Various Diluters, Cooling Rates, Temperature of Storage and Some Other Factors on the Livability of Spermatozoa in Stored Samples of Bull Semen. Cornell Ag. Expt. Sta. Memoir 249. 1949.

30. WINTERS, L. M., AND COMSTOCK, R E. Prenatal Development of the Bovine. Univ. of Minn. Tech. Bul. 151. 1942.

31. WISNICKY, WALTER, AND CASIDA, L. E. A Manual Method for the Diagnosis of Pregnancy in Cattle. J. Am. Vet. Med. Assn. 113. 451. 1948.

RELATIONSHIP of LIGNIN O OTHER CHEMICAL CONSTITUENTS IN SUDAN and MILLET FORAGES

L. L. RUSOFF
A. S. ACHACOSO
C. L. MONDART, JR.
and
F. L. BONNER

ULLETIN NO. 542

MAY 1961

LOUISIANA STATE UNIVERSITY
AND
AGRICULTURAL AND MECHANICAL COLLEGE
AGRICULTURAL EXPERIMENT STATION
Charles W. Upp, Director

CONTENTS

Pag

INTRODUCTION 3

REVIEW OF LITERATURE 4
- A. Nature and Chemistry of Lignin 4
- B. Determination of Lignin 5
- C. Effect of Maturity on Lignin and Other Plant Constituents . . 5
- D. Effects of Rate of Nitrogen Fertilization on Lignin, Other Plant Constituents and Yield of Forage Crops 6
- E. Interrelationship Between Lignin and Other Constituents 7
- F. Effect of Lignin on Nutritive Value 7

MATERIALS AND METHODS 9
- A. Description of Forage Used 9
- B. Planting of Forage and Rate of Fertilizer Application 10
- C. Sampling of Forage for Chemical Analysis and Harvesting for Silage Yield 10
- D. Methods of Analysis 11
- E. Statistical Analysis 12

RESULTS AND DISCUSSION 12
- A. Chemical Composition of Sudan and Millet Forages as Affected by Stage of Maturity and Rate of Nitrogen Application . 12
- B. Yield of Forage as Affected by Rate of Nitrogen Application . . 19
- C. Relationship among Certain Chemical Constituents 20
- D. General Discussion 21

SUMMARY 23

APPENDIX 24

REFERENCES 29

Relationship of Lignin to Other Chemical Constituents in Sudan and Millet Forages

L. L. Rusoff,[1] A. S. Achacoso,[2] C. L. Mondart, Jr.,[3] and F. L. Bonner[4]

INTRODUCTION

The chemical composition of pasture herbage and, correspondingly, its nutritive value depend primarily on the degree of maturity attained by the plants at the time of cutting or when grazed. It is also affected by the extent of fertilizer application, particularly nitrogen. The primary objective in any study of the chemical composition of forages is to obtain an indication of its nutritive value. Nutritional experiments or feeding trials and chemical composition data have attested that as maturity progresses, the nutritive quality is lowered, with the greatest relative change occurring in the protein and lignin fractions.

Not only does the application of nitrogen fertilizer affect the chemical composition of forage crops, but it also affects the yield, especially of the non-legume forage crops.

The percentages of crude protein and crude fiber have generally been used as criteria for forage quality. However, some investigators (*22, 29, 71*)[5] have criticized the validity of the crude fiber fraction in predicting digestibility and nutritive value since it is a fraction of unpredictable biological significance and of variable composition. Crampton and Maynard (*22*) proposed the determination of lignin, a constituent in plants which progressively increases with age and is not only unavailable to the ruminant but also has an adverse effect on the availability of other constituents. Patton and Gieseker (*76*) gave further evidence that more attention be given this substance in forage analyses.

Very limited studies have been made with Sudan and millet forages, two summer pasture grasses commonly grown in the Southern States. Chemical composition data on these forages as affected by stages of maturity and rates of nitrogen fertilization, and also data on the effect of varying rates of nitrogen application on their yield, are very limited. Therefore, this study was undertaken in 1958 with Sudan and millet forages with the following objectives: (1) to determine the effects of stage of maturity and increasing rates of nitrogen fertilization on the lignin content and other chemical constituents; (2) to determine the effect of different rates of nitrogen on silage yield; and (3) to determine the relationships among lignin, crude protein and crude fiber as affected by these treatments.

---

[1] Nutritionist, Dairy Department.

[2] Graduate Assistant, Dairy Department.

[3] Assistant Agronomist, Agronomy Department.

[4] Associate Chemist, Feed and Fertilizer Laboratory.

[5] Italic numbers in parentheses refer to References, Page 29.

REVIEW OF LITERATURE

A. Nature and Chemistry of Lignin

In light of our present knowledge of lignin chemistry, lignin ma be defined as that encrusting material of the plant which is built u mainly, if not entirely, of phenylpropane building units. It carries th major part of the methoxyl content of the wood, is unhydrolyzable b acid, readily oxidizable in hot alkali and bisulfite, and readily condense with phenols and thio compounds (*9*). Lignin gives rigidity to plants.

1. Chemistry of Lignin.—Lignin consists only of carbon, hydroge and oxygen. The small amount of nitrogen found in lignin preparation is probably the result of the presence of a small amount of protei which occurs in plants and is hydrolyzed only with difficulty. Its compc sition changes not only with its source but also with the method use in its preparation from the same source, and under different condition The theoretical analytical composition has been reported as follow 67.74 per cent carbon, 6.45 per cent hydrogen, 16.67 per cent methox and 9.14 per cent hydroxyl (*9*).

Chemically, lignin isolated from plants is not a single compoun but a group of similar organic substances. These contain methoxyl an phenolic groups and aromatic nuclei, and have a carbon-oxygen rati higher than that of true carbohydrates. Its exact structure still remain obscure, and a number of structural formulas have been proposed (*3* *53, 77, 94*). Kurschner (*53*) presented this empirical formula ($(C_{20}H_{22}O$ with the structure as shown in Figure 1.

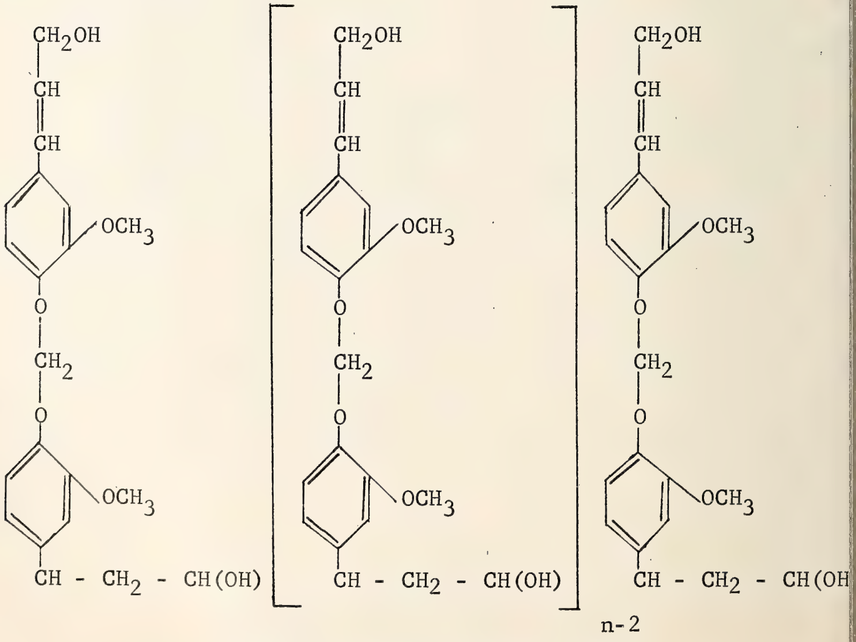


FIGURE 1.—Kurschner's formula for lignin.

2. Formation of Lignin.—The formation of lignin in the plant is still obscure, and although its chemical structure is as yet unknown, many suggestions are found in the literature concerning the nature of the parent substance and the possible mechanisms involved in the synthesis of lignin by the plant. A number of investigators (*23, 36, 40*) have suggested that lignin is formed by the plant from cellulose, while others *(31, 50)* believe that lignin is formed from pentoses. Rassow and co-workers (*87*) have pointed out that plant material with high lignin content has a low content of pentosans or vice versa, thus suggesting that lignin, at least in part, is built up by plants from pentosans. Phillips and co-workers *(79, 81, 82)*, in their investigations on the composition of growing annual plants, found no direct evidence that these plants synthesized lignin from cellulose, pentosans or pectins. They believed that lignin is produced by the plant directly from glucose or sucrose, the first step being the production of a substance or substances having firmly bound methoxyl groups which may be formed in the course of splitting up of carbohydrates by a process of hydrolysis, oxidation, reduction and dehydration.

B. Determination of Lignin

The goal in the determination of lignin is to isolate lignin quantitatively from liquefied materials by the removal of the non-lignin components such as cellulose, the hemi-celluloses and other constituents. (*9*). The earlier work has been reviewed by Thomas and Armstrong (*108*) and Harris (*41*). The methods for the quantitative determination of lignin can be classified as direct or indirect *(78)*. In the former, lignin is isolated as an insoluble product, with cellulose and other components being removed by hydrolysis; in the latter, a characteristic group of lignin, such as methoxyl, is determined and the lignin content calculated by a suitable factor. A characteristic chemical reaction may also be used, or the lignin can be removed by suitable oxidation, leaving the non-lignin components which are weighed and the lignin thus estimated by difference (*9*).

The present methods available for the quantitative determination of lignin in feedstuffs are largely derived from the methods employed in wood analysis, and are still far from satisfactory, particularly with immature plants (*61*). For determinations of lignin in most plants, the direct methods have usually been preferred (*22, 61, 108*). However, one must guard against two possible errors, namely, the degradation of lignin, and the production of breakdown products capable of condensing with lignin or of remaining totally insoluble (*108*). It is toward the prevention of possible errors due to interfering substances that modifications subsequently applied to original methods have been developed (*1, 4, 11, 22, 25, 34, 56, 62, 63, 72, 107*).

C. Effect of Maturity on Lignin and Other Plant Constituents

Probably, the most important factor that influences the composition of a plant is the stage of maturity it had reached when clipped or grazed.

It is a well-known fact that certain progressive changes in compositio are incident to advancement of maturity. This is characterized by rapi elongation of the stem during the period immediately preceding bloom and the resulting changes in the leaf-stem ratio. As the plant matures the moisture content decreases and the dry matter content increases correspondingly. Of the dry matter content, the percentage of crude protei *(8, 15, 18, 32, 46, 52, 67, 70, 80, 97, 98, 99)* decreases, the percentages of lignin *(5, 26, 30, 59, 68, 69, 74, 75, 76, 79, 82, 81, 84, 85, 93, 96, 101, 104)* an crude fiber *(3, 7, 15, 21, 35, 37, 42, 47, 84, 97, 99, 104, 112)* increase, th percentage of nitrogen-free extract *(42, 46, 114)* generally increases, an the percentages of ash *(7, 37, 68, 80, 114)* and ether extract *(42, 46, 114* remain about the same, although they may be variable.

Studies at the Washington Agricultural Experiment Station (*79, 80* *81, 82, 83*) on the chemical composition of several grasses at differen stages of growth have shown that the percentage of lignin increases in regular manner. Sosulski and co-workers (*96*) found that the lignin content of the plant parts of the grasses studied increased continuously fron the early pasture or boot stage to flowering, depending on the species Other investigators (*5, 85, 101*) found the same trend up to the flowerin stage, followed by a marked increase in rate up to seed formation.

D. Effects of Rate of Nitrogen Fertilization on Lignin, Other Plan Constituents and Yield of Forage Crops

Nitrogen fertilization has been shown to affect the chemical composition, yield and nutritive value of forage plants (*2, 10, 13, 43, 44, 45, 51* *60, 65, 66, 74, 86, 88, 92, 103, 111*). Most of the early work has been conducted primarily to study the effect of varying rates of nitrogen on yields of dry matter and crude protein, and also on the percentage of protein. It has been shown that the application of nitrogen fertilizer to pure stands of grass has increased yields of grasses on most soils. Broyles and Fribourg (*10*), in their study to determine the effects of three nitrogen-fertilization levels and four cutting intensities on the forage yields and nitrogen contents of four summer annual grasses, found a corresponding increase in dry matter yields with increases in nitrogen application from zero to 120 pounds. Similar results were reported by several workers in Puerto Rico (*91, 110, 111*). Vicente-Chandler and co-workers (*111*) found increases in yields of napiergrass, paragrass and guineagrass up to the 800-pound level. Results obtained by Mondart and Owen (*60*) in 1957, on a rate-of-nitrogen test on Sudan grass and millet, showed increases but no significant differences in yield of silage among rates of nitrogen treatments.

In Scotland, studies (*43, 44, 45*) on the effects of massive applications of nitrogen, with and without phosphate and potash, on yield and chemical and botanical composition of grassland herbage showed significant linear relationship between the quantity of nitrogen applied and the average crude protein content of the herbage. This was attributed to an increase in leaf-stem ratio toward the end of the season. Results also indicated an inverse relationship between per cent dry matter and the quantity of nitrogen applied. Other workers (*12, 14, 16, 17, 24, 55*) obtained similar results.

The effect of nitrogen on the percentage of structural components is variable. Norman (*70*) found no appreciable difference in the lignin content of orchard grass from fertilized and unfertilized plots. Lignin increased from an initial 7.9 per cent to 12.1 and 12.4 per cent in the unfertilized and fertilized plots, respectively. In a 9-year study with pasture plants in Virginia, Eheart and Ellett (*28*) found no significant difference in the percentage of crude fiber in fertilized and unfertilized forages when nitrogen was applied at different rates up to 150 pounds per acre. However, at the first cutting for all years, crude fiber percentages were significantly higher in grasses from fertilized plots than in those obtained from unfertilized check plots. Increase in percentage of ether extract with each fertilizer level and cutting, and decreases in percentage of nitrogen-free extract in all treatments except the 50-pound level were obtained.

Knox and co-workers (*51*) studied the effects of all combinations of fertilizers supplying nitrogen at 0, 100, 300, 600 and 900 pounds per acre annually in two applications, and cutting at intervals of 2, 3, 4, 6 and 8 weeks on a pure stand of Coastal Bermuda grass. It was found that the lignin content decreased with cutting intervals of 2 or 3 weeks as application of nitrogen increased. The reverse was obtained with cuttings at 6 or 8 weeks; with an application of 100 pounds of nitrogen the grass had no more lignin than when it was 2 or 3 weeks old. When more nitrogen was added, lignin increased with age.

E. Interrelationship between Lignin and Other Constituents

In the production of high-quality forage, it is very important to know the relative changes that occur in plants during growth. The upward trends of lignin, crude fiber and cellulose, and the downward trends of crude protein, ether extract and acid-insoluble ash point to the probability of a close relationship among these constituents. Results (*84, 104*) obtained at the New Hampshire Agricultural Experiment Station have shown highly significant positive correlation among constituents within each group and a significant negative correlation between any two constituents of the different above groups. Watkins and Kearns (*113*) found an average correlation of 0.84 between crude fiber and lignin contents of the grasses studied.

F. Effect of Lignin on Nutritive Value

Because forage plants contain relatively large amounts of lignin which increases with maturity, changes in this constituent have been considered as a partial explanation of the lowered feeding value of matured forages. In general, studies (*20, 22, 26, 33, 39, 47, 57, 76, 84, 85,*

TABLE 1.—Correlation Coefficients as Reported by Several Investigators

Forage Used	Correlation Coefficient (n)	Investigator
	Lignin and Dry Matter Digestibility	
Alfalfa	— .939	Phillips and Loughlin, 1949, *(83)*
	— .744[a]	Richards, Weaver and Connolly, 1958. *(90)*
Orchard grass	.985	”
Sudan grass	.280[a]	”
Timothy	— .954	Phillips and Loughlin, 1949, *(83)*
Pasture forage (predominantly timothy)	— .989	Richards and Reid, 1952, *(89)*
	Lignin and Organic Matter Digestibility	
Av. of 3 grasses and 2 legumes	— .950[b]	Forbes and Garrigus, 1950, *(34)*
Av. of 5 grasses and 4 legumes	— .930[c]	”
Av. for a wide range of New Zealand feeding-stuffs	— .978	Lancaster, 1943, *(54)*
	Lignin and Total Digestible Nutrients	
Alfalfa	— .880	Meyers and Lofgreen, 1956, *(58)*
Oat hay	— .980	Meyers, Weir, Jones and Hull, 1957, *(59)*
Kentucky bluegrass	— .930	Forbes and Garrigus, 1950, *(34)*
Av. of 3 grasses and 1 legume	— .960	”

[a] Insignificant; all others significant at the 1% level.
[b] Value using steers.
[c] Value using wethers.

100, 102, 105, 106) have shown that lignin in plants is not only practically indigestible but also decreases the availability of other constituents. Patton and Gieseker (*76*) claimed that lignin acts as a physical barrier to the microorganisms and fauna of the rumen, impeding the digestion of the cytoplasm it occludes. Several investigators (*33, 54, 58, 59, 83, 89, 90*) have shown high negative correlations between lignin and dry matter digestibility, and lignin and total digestible nutrients. However, Richards and co-workers (*90*) found a significant positive correlation between lignin and dry matter digestibility. The values obtained by several investigators are summarized in Table 1.

Effect of nitrogen fertilization on yield of millet and Sudan. Left to right: 240 lbs., 0 lbs., and 60 lbs. nitrogen per acre.

MATERIALS AND METHODS

A. Description of Forage Used

1. Tift Sudan.– This variety was developed and increased at the Coastal Plain Experiment Station in Georgia in 1936. It matures slightly later than other Sudan grass varieties and tends to develop slower than common Sudan. It is highly resistant to diseases and is best adapted to the humid Southeastern United States and parts of Texas. Certified seed are available.

2. Common Millet.–Common pearl millet, sometimes called cattail millet, is not a specific variety but is commercial seed with no varietal identity. Different seed lots may vary in yield and other characteristics. Pearl millet is upright in growth and will normally attain a height of

6 to 10 feet at maturity. The stems are coarse and grow in thick clump Leaves are normally about one inch wide and two to three feet long.

3. Gahi–1 Millet.–This was developed by the Georgia Coastal Plai Experiment Station. Four inbred lines were involved in the productio of this hybrid. It is characterized by good seedling vigor and is leafie later maturing and more productive than common cattail millet. It ha good recovery after grazing. It was released in 1958, cooperatively by th Georgia Coastal Plain Experiment Station and U.S.D.A., ARS. Certifie seed are available.

B. Planting of Forage and Rate of Fertilizer Application

This experiment was designed as a split-plot with four replications The plots were 10.5 feet by 14 feet and were divided into three rows o 3.5 by 14 feet. Tift Sudan, common millet and Gahi–1 millet were planted on June 5, 1958, at the same planting rate based on the number o pure live seed and were treated with 0, 30, 60, 120 and 240 pounds o nitrogen per acre. Half of the allotted nitrogen and 600 pounds o 0-14-14 were applied in the drill before planting. The remainder of th nitrogen was applied as a side dressing. All plots were cultivated onc to control weeds.

C. Sampling of Forage for Chemical Analyses and Harvesting for Silag Yield

Forage samples for analysis were obtained from the two guard row on each treatment. The first cutting on all treatments and varietie was made when the plants attained a height of 30 to 35 inches. Subsequent cuttings were made at 10-day intervals until the plants ha seeded out. The plants were cut back to a 6-inch stubble with the us of a hand clipper. Sampling dates of forages are shown in Table 2, and the average heights attained by the plants at each cutting are presented in Table 3. The center rows on all treatments were harvested for yield when they reached the silage stage, or approximately at the stage between boot and full bloom.

The fresh cut samples were weighed on a field scale shortly after cutting, then chopped and placed in cloth bags for drying in a forage dryer at 65° C. The dried samples were allowed to stand at room temperature before air-dry weights were taken. The samples were then

TABLE 2.–Sampling Dates of Forages

Rate of Nitrogen (lb./acre)	Date of Cutting				
	First	Second	Third	Fourth	Fifth
0	7- 9-58	7-19-58	7-29-58	8- 8-58	8-18-58
30	7- 5-58	7-15-58	7-25-58	8- 4-58	8-14-58
60	6-30-58	7-10-58	7-20-58	7-30-58	8- 9-58
120	6-30-58	7-10-58	7-20-58	7-30-58	8- 9-58
240	6-30-58	7-10-58	7-20-58	7-30-58	8- 9-58

TABLE 3.—Average Height of Plants at Time of Cutting

Cutting	Rate of Nitrogen (Lb./Acre) 0	30	60	120	240
	Inches				
	Tift Sudan				
First	32.2	30.2	31.8	34.0	36.5
Second	43.7	45.7	46.7	46.7	50.5
Third	57.7	59.0	60.0	63.2	62.7
Fourth	69.7	72.2	74.2	78.5	80.5
Fifth	75.5	77.2	80.2	83.2	82.7
	Gahi—1 Millet				
First	27.7	31.2	29.5	29.5	34.2
Second	39.7	45.0	41.0	45.0	47.0
Third	61.0	63.5	65.5	65.7	68.0
Fourth	69.7	74.5	84.5	86.7	97.0
Fifth	73.5	82.0	88.0	100.2	106.0
	Common Millet				
First	31.5	32.7	29.0	33.5	36.0
Second	45.5	47.2	44.2	49.2	50.5
Third	53.5	63.2	64.5	68.2	69.0
Fourth	64.7	63.2	80.0	81.7	87.7
Fifth	63.7	60.7	79.0	82.0	85.5

ground in a Wiley mill to pass a 20-mesh sieve. Aliquots from each sample were stored in sealed bottles for chemical analyses.

D. Methods of Analysis

Percentages of moisture, crude protein, crude fiber, fat and ash of the forage samples were determined according to the procedures recommended by the Association of Official Agricultural Chemists (*6*). Nitrogen-free extract was obtained by difference. The lignin content was determined on the dried samples using a slight modification of the procedure of Moon and Abou-Raya *(63)* on the determination of "total lignin." The procedure in this study involved the following: One-gram samples, in quadruplicate, were weighed and each wrapped individually with Whatman filter paper No. 42. The samples were extracted with a 1:2 ethanol-benzene mixture in a large Soxhlet apparatus for 30 hours, then exposed to room temperature to allow the ethanol-benzene mixture to evaporate before they were placed in the oven to dry. The dried residues were carefully transferred into Phillips beakers (250-ml.) for incubation overnight (18 hours) at 40° C. with 1 per cent pepsin in 0.1N hydrochloric acid (40 ml. per gram of original material). The samples were filtered through an asbestos mat with the aid of suction, then washed with hot water and dried with small portions of alcohol and ether. The dried material, including the asbestos mat, was transferred back to the Phillips beakers and digested with 72 per cent sulfuric acid (30 ml. per gram of original material) at 20° C. for 2 hours with occasional stirring. The resulting mixture was then diluted up to six volumes with water and immediately filtered, washed with 0.1N hydrochlori acid, alcohol and ether. The dried residues were transferred into 600-m beakers and refluxed with approximately 200 ml. of 3 per cent sulfuri acid for 2 hours, finally filtered while hot and washed with hot wate alcohol and ether. The dried residues were carefully transferred int crucibles for drying in an oven overnight at 100° C. Ash-free lignin wa determined on two sample residues by loss on ignition at 600° C. Th other two residues were analyzed for nitrogen in lignin using 4 pe cent boric acid to receive nitrogen (*6*). Ash-free lignin was then correcte for nitrogen to obtain corrected lignin values.

E. Statistical Analysis

The analysis of variance as outlined by Snedecor (*95*) was used t evaluate the effects of rates of nitrogen application and cutting on ligni and other chemical constituents, and also the effects of rate of nitroge application on yield of forage for silage. Duncan's multiple range tes (*27*) was employed when significant differences were obtained to detec where the differences existed. Correlation coefficients (*95*) were determined to examine the relationships among lignin, crude protein crude fiber and dry matter.

RESULTS AND DISCUSSION

A. Chemical Composition of Sudan and Millet Forages as Affected b Stage of Maturity and Rate of Nitrogen Application

The data on the chemical composition of Tift Sudan and commo and Gahi–1 millets at different stages of growth and rates of nitroge fertilization are given in Tables 4 to 10, inclusive. All results are reporte on the dry-matter basis. Analysis of variance on each constituent is give in Appendix Tables 1a through 7a, and Duncan's multiple range tes on the means is shown in Appendix Table 8a.

1. Stage of Maturity.—It has been shown in the literature that stag of maturity accounted for marked changes in the chemical compositio of forage plants.

a. Lignin.—Table 4 shows that the lignin content of the forages progressively increased as the plants matured. On the average, lignin increased from 3.23 per cent to 6.72 per cent on the first and fifth cuttings respectively. Analysis of variance as shown in Appendix Table 1a reveal that a highly significant difference existed in the lignin content of th plants at successive cuttings. However, Duncan's test (Appendix Tabl 8a) on the means showed no significant difference between the values a the third and fourth cuttings. The greatest increase was obtained at th third cutting, a period characterized by rapid stem elongation. Increase in lignin content as maturity progresses has been reported in the literature by a number of investigators. Studies (*84*) at the New Hampshire Station showed an average increase from 3.38 to 7.35 per cent in the lignin content of several grasses at the vegetative and dough stages, re-

TABLE 4.—Average Lignin Content of Sudan and Millet Forages at Different Stages of Growth and Rates of Nitrogen Fertilization (Dry Matter Basis)

	Rate of Nitrogen (Lb./Acre)					
Cutting	0	30	60	120	240	Average
	Per Cent					
			Tift Sudan			
First	3.56	3.42	2.88	2.44	2.56	2.97
Second	3.85	4.38	3.69	3.49	4.55	3.99
Third	4.19	3.94	5.33	5.67	5.41	5.12
Fourth	6.40	6.62	5.73	6.27	7.52	6.51
Fifth	7.42	8.31	6.94	6.03	7.22	7.18
Average	5.08	5.53	4.91	4.78	5.45	5.15
			Gahi—1 Millet			
First	3.24	2.69	3.15	3.03	3.86	3.19
Second	4.09	3.88	2.96	3.52	3.80	3.65
Third	5.11	4.77	5.86	5.41	5.52	5.33
Fourth	5.02	6.07	5.70	6.55	7.09	6.09
Fifth	5.16	6.90	5.81	6.59	7.45	6.38
Average	4.52	4.86	4.70	5.02	5.54	4.93
			Common Millet			
First	3.16	3.40	3.50	2.54	4.99	3.52
Second	4.68	4.33	3.82	3.64	4.62	4.22
Third	5.19	5.52	4.83	6.16	6.76	5.69
Fourth	5.73	5.79	6.74	6.87	6.34	6.29
Fifth	6.18	6.99	6.66	6.38	6.81	6.60
Average	4.99	5.21	5.11	5.12	5.90	5.27
			Average			
First	3.32	3.17	3.18	2.67	3.80	3.23
Second	4.21	4.20	3.49	3.55	4.32	3.95
Third	4.83	5.08	5.34	5.75	5.90	5.38
Fourth	5.72	6.16	6.06	6.56	6.98	5.62
Fifth	6.25	7.40	6.47	6.33	7.16	6.72
Average	4.87	5.20	4.91	4.97	5.63	

spectively. A similar relationship was also obtained in studies *(75, 76)* with Montana grasses. Results *(51)* at the Georgia Experiment Station on Bermuda grass fertilized with 600 pounds of nitrogen per acre showed that lignin increased from 9.45 per cent to 12.05 per cent with an increase in age from 2 to 8 weeks. Vicente-Chandler *et al. (111)* also reported similar increases with three tropical grasses fertilized with 800 pounds of nitrogen.

b. Crude Protein.—The percentage of crude protein (Table 5) declined significantly ($P<.01$) at each successive stage of cutting, as was expected. The mean value dropped from 13.1 to 5.9 per cent at the first and last cuttings, respectively, with a relatively small decline in all three forages at the first two cuttings. The observed decline at the first two cuttings is in agreement with the results of Armstrong *et al. (5)* on cocksfoot and ryegrass. However, studies by several investigators (*8, 67, 84, 114*) on several grasses at successive stages of growth showed a more

TABLE 5.—Crude Protein Content of Sudan and Millet Forages at Different Stage of Growth and Rates of Nitrogen Fertilization (Dry Matter Basis)

	Rate of Nitrogen (Lb./Acre)					
Cutting	0	30	60	120	240	Average
	Per Cent					
			Tift Sudan			
First	11.8	10.8	11.7	13.4	18.7	13.3
Second	9.4	13.5	12.7	15.0	15.0	13.1
Third	6.6	8.9	12.2	14.4	15.5	11.5
Fourth	5.5	7.2	8.4	10.0	11.5	8.5
Fifth	5.9	6.2	6.1	7.9	9.4	7.1
Average	7.8	9.3	10.2	12.1	14.0	10.7
			Gahi—1 Millet			
First	11.7	10.4	13.8	13.8	18.3	13.6
Second	8.3	10.1	12.8	14.6	16.5	12.5
Third	5.7	6.8	10.0	12.9	16.6	10.4
Fourth	6.0	5.9	6.8	7.2	10.0	7.2
Fifth	5.4	4.6	4.5	5.2	7.7	5.5
Average	7.4	7.6	9.6	10.7	13.8	9.8
			Common Millet			
First	10.7	9.2	11.2	12.4	18.1	12.3
Second	8.5	10.5	12.4	13.1	15.1	11.9
Third	6.4	6.3	8.3	10.0	14.5	9.1
Fourth	4.3	5.0	6.6	6.7	8.8	6.3
Fifth	4.9	4.7	4.8	5.3	6.6	5.3
Average	7.0	7.1	8.7	9.5	12.6	9.0
			Average			
First	11.4	10.1	12.2	13.2	18.4	13.1
Second	8.7	11.4	12.6	14.2	15.5	12.5
Third	6.2	7.3	10.2	12.4	15.5	10.3
Fourth	5.3	6.0	7.3	8.0	10.1	7.3
Fifth	5.4	5.2	5.1	6.1	7.9	5.9
Average	7.4	8.0	9.5	10.8	13.5	

rapid decline at the earlier stages, probably as a result of a period o rapid stem elongation.

c. Crude Fiber.—The effect of advancing maturity on crude fiber i shown in Table 6. On the average, crude fiber increased up to the fourth cutting (25.4 to 34.8 per cent), with the increases at each successive stage being highly significant. This was followed by a significant decline (34.8 to 33.5 per cent) at the fifth cutting, which was probably due to the formation of seeds. The observed decline is in agreement with results obtained in a study (*84*) at the New Hampshire Agricultural Experiment Station on grasses up to the seed dough stage.

d. Dry Matter, Nitrogen-free Extract, Ether Extract and Ash.—The percentages of dry matter, nitrogen-free extract, ether extract and ash are presented in Tables 7, 8, 9, and 10, respectively. Highly significant increases ($P < .01$) in dry matter content (Appendix Table 4a) were obtained at each successive cutting on all treatments, with the greatest

TABLE 6.—Crude Fiber Content of Sudan and Millet Forages at Different Stages of Growth and Rates of Nitrogen Fertilization (Dry Matter Basis)

Cutting	Rate of Nitrogen (Lb./Acre) 0	30	60	120	240	Average
	Per Cent					
			Tift Sudan			
First	26.8	25.8	23.6	23.9	17.0	23.4
Second	31.5	25.8	25.9	24.2	28.6	27.2
Third	32.1	32.0	30.1	30.7	30.7	31.1
Fourth	33.8	35.5	32.9	33.8	33.7	33.9
Fifth	35.5	36.2	34.0	32.7	32.4	34.2
Average	31.9	31.1	29.3	29.1	28.5	30.0
			Gahi—1 Millet			
First	27.6	27.6	25.4	28.0	25.6	26.8
Second	32.5	28.5	27.7	28.4	25.0	28.4
Third	34.2	34.5	35.4	33.6	32.7	34.1
Fourth	33.0	37.3	36.5	36.5	32.7	34.1
Fifth	37.7	36.8	34.9	36.3	34.4	36.0
Average	33.0	32.9	32.0	32.6	31.0	32.3
			Common Millet			
First	27.1	26.1	25.9	25.7	25.1	26.0
Second	35.6	29.4	28.2	27.1	28.3	29.4
Third	33.3	36.3	36.1	35.4	36.2	35.5
Fourth	30.4	33.9	36.6	35.8	35.4	34.4
Fifth	29.6	31.0	30.7	30.8	29.5	30.3
Average	31.2	31.3	31.5	31.0	30.9	31.2
			Average			
First	27.2	26.5	25.0	25.9	22.6	25.4
Second	33.2	27.9	27.3	26.6	27.3	28.4
Third	33.2	34.3	33.9	33.2	33.2	33.5
Fourth	32.4	35.6	35.3	35.4	35.4	34.8
Fifth	34.3	34.7	33.2	33.3	32.1	33.5
Average	32.0	31.8	30.9	30.9	30.1	

increase obtained at the last cutting. After an initial decline, nitrogen-free extract also followed a similar trend. On the other hand, the ether extract and ash contents in all three forages declined as the plants matured. These results conform with the findings of other investigators (*4, 83*).

It can be seen in Tables 4 through 10 that the chemical constituents of the forages studied were affected by stages of growth (cutting), regardless of nitrogen treatments.

2. Rate of Nitrogen Fertilization.—According to the literature, various levels of nitrogen have been shown to affect the chemical composition of forage plants.

a. Lignin.—The lignin content of the forages (Table 4) increased significantly ($P<.01$) with increasing levels of nitrogen, with an average of 4.87 per cent and 5.63 per cent on forages receiving 0 and 240 pounds of nitrogen per acre, respectively. These increases might probably be due

TABLE 7.—Dry Matter Content of Sudan and Millet Forages at Different Stage of Growth and Rates of Nitrogen Fertilization

	Rate of Nitrogen (Lb./Acre)					
Cutting	0	30	60	120	240	Average
			Per Cent			
			Tift Sudan			
First	13.9	12.1	11.6	11.6	11.1	12.0
Second	15.4	14.1	14.3	14.5	14.5	14.6
Third	18.6	20.1	18.4	15.2	18.5	18.2
Fourth	23.1	23.1	22.0	18.4	22.1	21.7
Fifth	28.0	23.3	30.0	27.5	27.6	27.3
Average	19.8	18.5	19.3	17.4	18.8	18.8
			Gahi—1 Millet			
First	14.7	12.7	9.6	10.0	11.3	11.6
Second	15.6	13.8	13.4	13.1	13.2	13.8
Third	16.9	17.0	14.9	14.8	15.4	15.8
Fourth	23.1	18.6	18.4	18.5	18.2	19.4
Fifth	25.6	25.7	23.3	25.3	27.6	25.5
Average	19.2	17.6	15.9	16.3	27.6	25.5
			Common Millet			
First	11.6	12.7	10.0	10.6	10.7	11.1
Second	17.0	15.5	12.8	15.9	11.9	14.6
Third	18.7	21.8	18.6	16.8	15.3	19.3
Fourth	23.1	23.0	22.2	18.3	25.7	22.5
Fifth	27.6	27.7	30.0	32.3	32.5	30.0
Average	19.6	20.2	18.7	18.8	19.2	19.3
			Average			
First	13.4	12.5	10.4	10.7	11.0	11.6
Second	16.0	14.5	13.5	14.5	13.2	14.3
Third	18.1	19.7	17.3	15.6	16.4	17.4
Fourth	23.1	21.6	20.9	18.4	22.0	21.2
Fifth	27.1	25.6	27.8	28.4	29.2	27.6
Average	19.5	18.8	18.0	17.5	18.4	

to the production of bigger stems to support more vigorous growth of leaves. Studies by Phillips *et al. (81)* on the lignin content of wheat showed an increase from 14.54 to 15.82 per cent lignin when 300 and 600 pounds of nitrogen were applied early in growth, and from 14.25 to 14.77 per cent when the nitrogen was applied at heading time. Plants receiving no nitrogen contained 13.64 per cent. Knox *et al. (51)* at the Georgia Experiment Station showed that 8-week-old Bermuda grass treated with up to 100 pounds of nitrogen had no more lignin than Bermuda grass 2 or 3 weeks old, but when more nitrogen was applied, the lignin content increased with age.

Appendix Table 8a shows that plants on the highest nitrogen treatment had significantly higher lignin contents than those at the lower levels. There were no significant differences among the lignin values at the 0-, 30-, 60- and 120-pound levels. Results obtained by Knox and co-workers *(51)* showed that when Bermuda grass was clipped at 2-week

TABLE 8.—Nitrogen-Free Extract Content of Sudan and Millet Forages at Different Stages of Growth and Rates of Nitrogen Fertilization (Dry Matter Basis)

Cutting	Rate of Nitrogen (Lb./Acre) 0	30	60	120	240	Average
			Per Cent			
			Tift Sudan			
First	46.4	47.7	51.9	49.6	50.7	49.3
Second	44.1	44.6	46.7	46.9	41.5	44.8
Third	48.0	46.1	44.7	42.7	41.5	44.6
Fourth	48.5	45.2	46.4	44.8	44.9	46.0
Fifth	46.6	51.1	50.0	49.5	49.5	49.3
Average	46.7	46.9	47.9	46.7	45.6	46.9
			Gahi—1 Millet			
First	43.9	43.9	44.8	41.0	38.9	42.5
Second	45.6	44.6	41.1	40.3	43.9	43.1
Third	47.2	45.6	41.2	39.8	39.4	42.6
Fourth	48.8	44.7	45.2	45.6	42.6	45.4
Fifth	44.9	48.5	49.9	49.3	49.5	48.4
Average	46.1	45.5	44.4	43.2	42.9	44.4
			Common Millet			
First	46.3	46.3	51.9	46.1	41.5	46.4
Second	41.3	43.3	43.7	43.4	41.0	42.5
Third	48.0	45.6	43.9	43.9	38.7	44.0
Fourth	53.8	50.4	46.6	47.1	46.6	48.9
Fifth	54.5	53.2	55.4	55.3	56.0	54.9
Average	48.8	47.8	48.3	47.2	44.8	47.3
			Average			
First	45.5	46.0	49.5	45.6	43.7	46.1
Second	43.7	44.2	43.8	43.5	42.1	43.5
Third	47.7	45.8	43.3	42.1	39.9	43.7
Fourth	50.4	46.8	46.1	45.8	44.7	46.7
Fifth	48.7	50.9	51.8	51.4	51.7	50.9
Average	47.2	46.7	46.9	45.7	44.4	

intervals, increasing rates of nitrogen decreased the lignin content of the harvested forages, but at 6- and 8-week intervals, lignin tended to increase with increasing increment of nitrogen.

b. Crude Protein.—The increase in crude protein content of the forages was linear up to 240 pounds of nitrogen per acre (Table 5). Crude protein averaged 7.4, 8.0, 9.5, 10.8 and 13.5 per cent at each increasing level of nitrogen application. These differences were statistically significant at the 1 per cent level of probability. Plants fertilized with 240 pounds of nitrogen had 82 per cent more protein than the control plants. Broyles and Fribourg (*10*) also showed corresponding increases in the percentages of crude protein of harvested Sudan grass and millet forages, with increases in nitrogen application from 0 to 120 pounds per acre.

c. Crude Fiber.—The effect of nitrogen fertilization on the crude fiber

TABLE 9.—Ether Extract Content of Sudan and Millet Forages at Different Stages of Growth and Rates of Nitrogen Fertilization (Dry Matter Basis)

Cutting	Rate of Nitrogen (Lb./Acre)					Average
	0	30	60	120	240	
	Per Cent					
			Tift Sudan			
First	3.6	3.1	2.7	2.7	2.9	3.0
Second	2.3	2.4	3.2	3.3	2.5	2.7
Third	2.4	2.8	2.8	2.8	2.7	2.7
Fourth	2.3	2.6	2.7	2.7	2.2	2.5
Fifth	2.6	2.3	2.5	2.5	2.3	2.4
Average	2.6	2.6	2.8	2.8	2.5	2.7
			Gahi—1 Millet			
First	1.9	2.5	2.4	2.9	3.1	2.6
Second	2.0	2.3	2.9	2.4	3.8	2.7
Third	1.9	1.8	2.3	2.3	2.2	2.1
Fourth	1.7	1.8	2.0	2.5	2.6	2.1
Fifth	1.9	1.7	1.6	1.5	1.7	1.7
Average	1.9	2.0	2.2	2.3	2.7	2.2
			Common Millet			
First	2.1	2.4	2.8	2.5	2.6	2.5
Second	1.4	3.3	2.2	2.5	2.2	2.3
Third	1.6	1.7	2.0	1.7	1.8	1.8
Fourth	1.7	1.5	1.5	2.9	2.2	2.0
Fifth	2.0	1.6	1.8	1.7	1.8	1.8
Average	1.8	2.1	2.1	2.3	2.1	2.1
			Average			
First	2.5	2.7	2.6	2.7	2.9	2.7
Second	1.9	2.7	2.8	2.7	2.8	2.6
Third	2.0	2.1	2.4	2.3	2.2	2.2
Fourth	1.9	2.0	2.1	2.7	2.3	2.2
Fifth	2.2	1.9	2.0	1.9	1.9	2.0
Average	2.1	2.2	2.4	2.5	2.4	

content of the forages is presented in Table 6. It is evident that crude fiber decreased significantly from 32.0 per cent at the 0 level to 30.1 per cent at the highest level of fertilization. However, there were no significant differences between the values obtained at 0 and 30 pounds, and among those obtained at 30-, 60- and 120-pound levels (Appendix Table 3a). The observed decline in crude fiber is in agreement with results obtained by Ramage and co-workers (*86*) in their study with orchard-grass.

d. Dry Matter, Nitrogen-free Extract, Ether Extract and Ash.—Increasing nitrogen rates up to 120 pounds per acre decreased the dry matter content of the plants (Table 7) from 19.5 per cent at the 0 level to 17.5 per cent. Plants receiving 240 pounds of nitrogen per acre contained 18.4 per cent dry matter. Statistical analysis (Appendix Table 4a) showed highly significant differences among the dry matter values at each level of nitrogen. However, there was no significant difference between the

TABLE 10.—Ash Content of Sudan and Millet Forages at Different Stages of Growth and Rates of Nitrogen Fertilization (Dry Matter Basis)

	Rate of Nitrogen (Lb./Acre)					
Cutting	0	30	60	120	240	Average
			Per Cent			
			Tift Sudan			
First	11.4	12.6	10.1	10.4	10.7	11.0
Second	12.7	13.7	11.5	10.6	12.4	12.2
Third	10.9	10.2	10.2	9.4	9.4	10.0
Fourth	9.9	9.5	9.6	8.7	7.7	9.1
Fifth	9.4	4.2	7.4	7.4	6.4	7.0
Average	10.9	10.0	9.8	9.3	9.3	9.9
			Gahi–1 Millet			
First	14.9	15.6	13.6	14.3	14.1	14.5
Second	11.4	14.3	15.5	14.3	10.8	13.3
Third	11.0	11.3	11.1	11.4	9.1	10.8
Fourth	10.5	10.3	9.5	8.2	7.7	9.2
Fifth	10.1	8.4	9.1	7.7	6.7	8.4
Average	11.6	12.0	11.8	11.2	9.7	11.2
			Common Millet			
First	13.8	16.0	8.2	13.3	12.7	12.8
Second	13.2	13.5	13.5	13.9	13.4	13.5
Third	10.7	10.1	9.7	9.0	8.8	9.7
Fourth	9.8	9.2	8.7	7.5	7.0	8.4
Fifth	9.0	9.5	7.3	6.9	6.1	7.8
Average	11.3	11.7	9.5	10.1	9.6	10.4
			Average			
First	13.4	14.7	10.6	12.7	12.5	12.8
Second	12.4	13.9	13.5	12.9	12.2	13.0
Third	10.9	10.5	10.3	9.9	10.1	10.0
Fourth	10.1	9.7	9.3	8.1	7.5	8.9
Fifth	9.5	7.4	7.9	7.3	6.4	7.7
Average	11.2	11.2	10.3	10.2	9.5	

values obtained at the 0- and 30-pound levels, those at 30, 60, and 240 pounds and those at 60, 120 and 240 pounds (Appendix Table 8a).

On the average, nitrogen-free extract and ash also decreased with increasing levels of nitrogen, as shown in Tables 8 and 10, respectively. The values for nitrogen-free extract at the fifth cutting tended to increase, while those of ash were variable at the first two cuttings as nitrogen levels were increased. No significant effect was obtained on ether extract; however, the values tended to decrease (Table 9).

Tables 4 through 10 show that increasing levels of nitrogen fertilization also influenced the chemical composition of the forages studied.

B. Yield of Forage as Affected by Rate of Nitrogen Application

The results on the yield of silage in tons per acre of Sudan and millet forages treated with varying rates of nitrogen are given in Table 11. Statistical analysis (Appendix Table 9a) showed highly significant dif-

TABLE 11.—Silage Yields of Sudan and Millet Forages with Varying Rates of Nitroge

Rate of Nitrogen (Lb./Acre)	Variety		
	Tift Sudan	Common Millet	Gahi–1 Mille
	Tons per Acre		
0	5.96	7.13	8.93
30	7.36	8.90	15.08
60	9.44	14.74	21.41
120	12.12	16.04	24.46
240	12.34	21.08	29.25

ferences among varieties and among nitrogen treatments. The interaction between varieties and nitrogen rates was also highly significant. Duncan's multiple range test (Appendix Table 10a) showed that Gahi–1 millet produced a significantly higher silage yield than Tift Sudan grass and common millet at all levels of nitrogen except the 0-level. Gahi–1 millet fertilized with 30 pounds of nitrogen produced as much as common millet treated with 120 pounds, and significantly ($P<.05$) more than Tift Sudan at the 240-pound level. Above the 30-pound nitrogen level, common millet was significantly better than Tift Sudan for silage yield.

The silage yield of Gahi–1 millet was increased significantly by each increased rate of nitrogen. Up to the 60-pound level, an increase of 0.21 ton of silage above the 0-pound level was obtained per pound of nitrogen. There was no difference in yield between the 60- and 120-pound levels.

The yield of common millet was not increased significantly by the addition of 30 pounds of nitrogen. However, the production at the 60-pound level was significantly higher than those obtained at the 0- and 30-pound levels. No significant difference in yield was obtained with common millet treated with 60 and 120 pounds of nitrogen. There was a significant increase in yield at the 240-pound level.

The yield of Tift Sudan grass showed no significant difference among the 0-, 30-, and 60-pound levels, nor among the 60-, 120-, and 240-pound levels. Tift treated with 120 and 240 pounds produced significantly higher yields than the check and 30 pounds.

In 1957, Mondart and Owens (*60*) found no significant differences among rate-of-nitrogen treatments. This was attributed to excessive water during late June which caused damage to the stand, especially to Sudan grass.

C. Relationship Among Certain Chemical Constituents

Correlation coefficients among the lignin, crude protein, crude fiber and dry matter contents of Sudan and millet forages are presented in Appendix Table 11a. Highly significant ($P<.01$) negative correlations were obtained between lignin and crude protein, crude protein and crude fiber, and crude protein and dry matter. Results also showed highly significant positive correlations between lignin and crude fiber, lignin and dry matter, and crude fiber and dry matter. It is evident that stage of maturity had the greatest influence on the relationship between these constituents. As the plants matured, crude protein decreased while lignin, crude fiber and dry matter increased. Similar values for the above relationships were obtained in studies conducted by Phillips *et al.* *(84)* at New Hampshire on several varieties of grass. Lancaster *(54)* also reported a high positive correlation between lignin and crude fiber.

D. General Discussion

The relative changes in the chemical composition of the forages with advancing maturity and increasing levels of nitrogen fertilization are

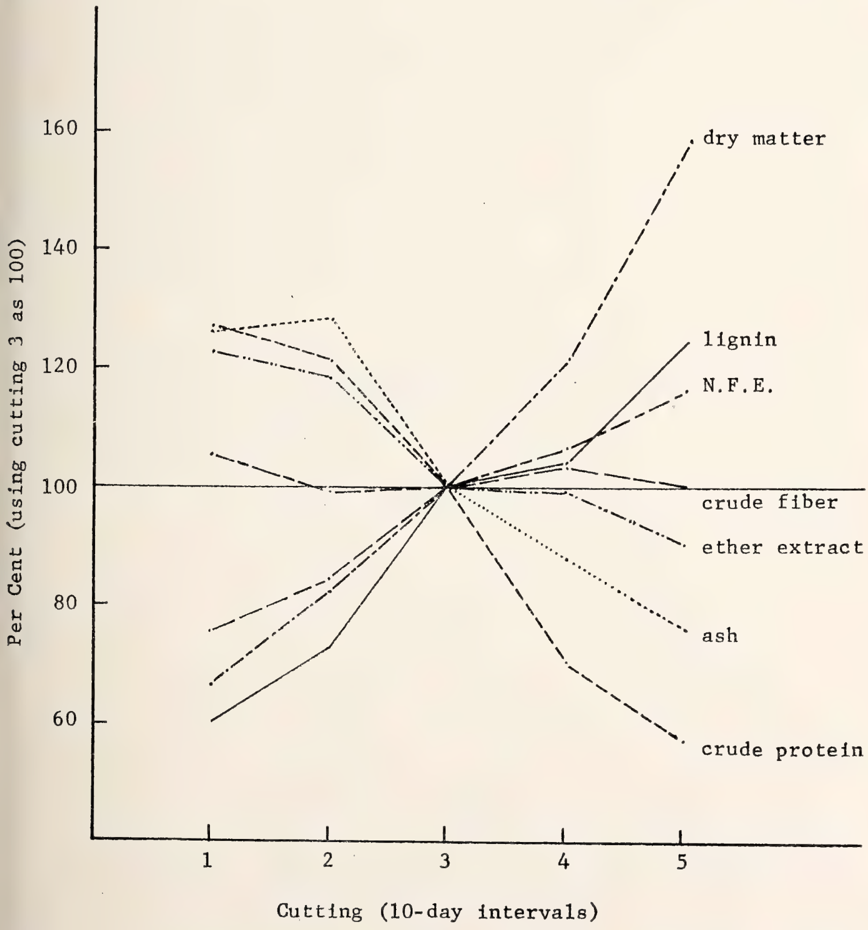


FIGURE 2.—Relative changes of some plant constituents in Sudan and millet with advancing maturity.

illustrated more clearly in Figures 2 and 3, respectively. It is evident that the greatest relative changes with aging of plant tissues occurred in the protein and lignin contents. In general, both lignin and crude fiber increased with maturity. With the millet forages, however, crude fiber did not increase continuously up to the seed stage. The decline in percentage of crude fiber in common millet at the last stage of cutting was apparently due to the formation of the grains, which resulted in an increase in percentage of nitrogen-free extract. It is also evident that the

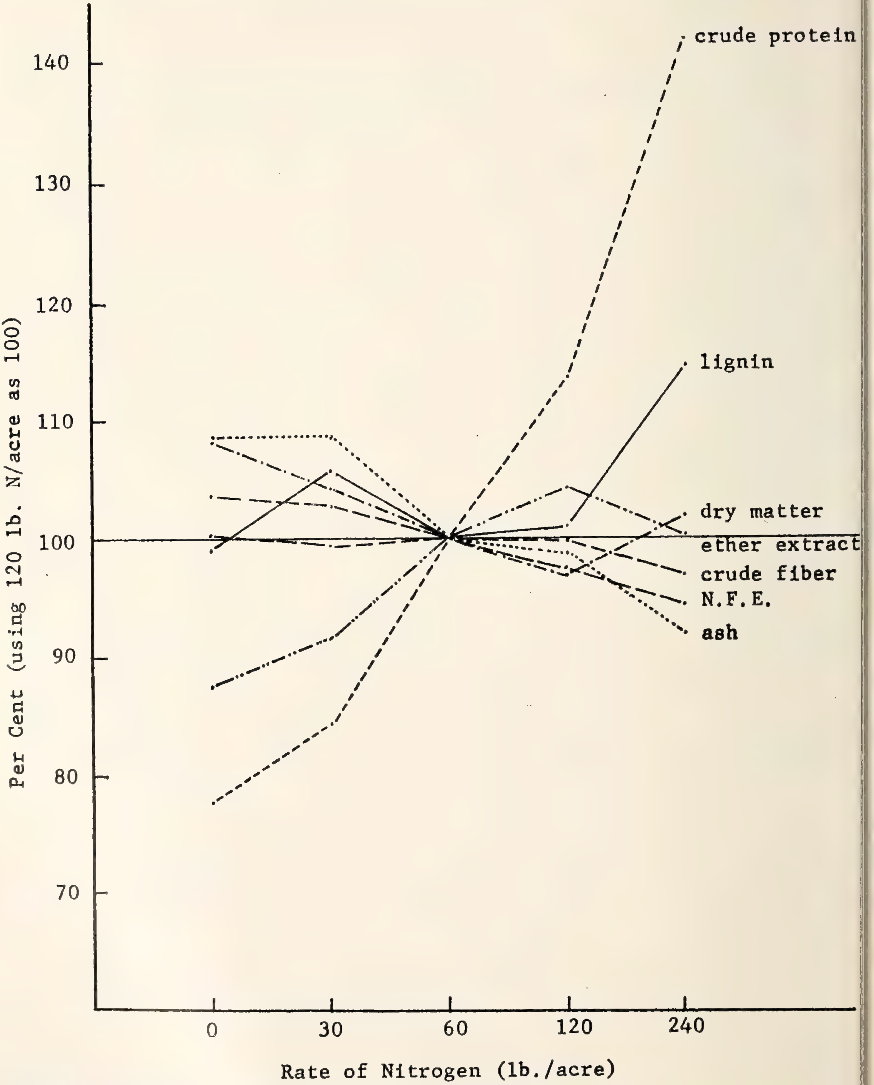


FIGURE 3.—Relative changes of some plant constituents in Sudan and millet with increasing levels of nitrogen application.

greatest effect of increasing levels of nitrogen was increasing the protein content of the plants. Up to 120 pounds of nitrogen, there were no significant increases in lignin content. On the other hand, crude fiber decreased with each increasing level of nitrogen. These changes can be attributed to an increase in leaf-stem ratio.

It has been shown by Lancaster (*54*) that the digestibility of crude fiber is closely related ($r = -0.954$) to lignin content. However, evaluation of forages was made not on the digestibility of crude fiber but on its percentage. Phillips and co-workers (*84*) stated that since lignin showed a more regular increase in percentage as plants matured, it could be considered a better criterion for quality of forage than crude fiber.

SUMMARY

The lignin content and other chemical constituents of two summer pasture grasses as well as the relationship among lignin, crude protein, crude fiber and dry matter as affected by stage of maturity and rates of nitrogen fertilization were studied. The yield of forage as affected by rate of nitrogen fertilization was also studied. Sudan and millet forages, fertilized with 0, 30, 60, 120 and 240 pounds of nitrogen per acre, in two applications, were cut at 10-day intervals. First cuttings on all treatments were made when the plants were 30-35 inches high. The plants were cut back to a 6-inch stubble. The forages were harvested for yield when they reached the silage stage, or approximately at the stage between boot and full bloom.

Results on both forages showed that lignin progressively increased with plant maturity, with values ranging from 3.23 per cent to 6.72 per cent on the first and fifth cuttings, respectively. The percentages of crude protein decreased significantly from 13.1 per cent to 5.9, with a relatively small decline between the first two cuttings. Crude fiber increased significantly, with a decline at the fifth cutting which was apparently due to seed formation, particularly in the millets. Gahi–1 millet produced a significantly higher silage yield than Tift Sudan and common millet at all levels of nitrogen application with the exception of 0-level.

No significant increases in lignin up to 120 pounds of nitrogen application per acre were obtained. Crude protein increased significantly from 7.4 to 13.5 per cent, while crude fiber decreased from 32.0 to 30.1 per cent at the 0- and 240-pound levels, respectively. However, there were no significant differences in the crude fiber content at the 30-, 60- and 120-pound levels. Dry matter, nitrogen-free extract and ash also increased.

Highly significant negative correlation coefficients were obtained between lignin and crude protein, crude protein and crude fiber and crude protein and dry matter. Positive correlations were obtained between lignin, crude fiber and dry matter at the 1 per cent level of probability.

APPENDIX

TABLE 1a.—Analysis of Variance for Lignin Content of Sudan and Millet Forages Different Stages of Growth and Rates of Nitrogen Fertilization

Source of Variance	d.f.	Sum of Squares	Mean Square	F-Value
Total	74	162.6160		
Nitrogen	4	6.0400	1.5100	5.17**
Cutting	4	134.4135	33.6034	115.00**
Variety	2	1.4627	.7313	2.50
N x C	16	6.3590	.3974	1.36
N x V	8	1.8552	.2319	<1
C x V	8	3.1362	.3920	1.34
Residual	32	9.3493	.2922	

**Significant at $P < .01$.

TABLE 2a.—Analysis of Variance for Crude Protein Content of Sudan and Mill Forages at Different Stages of Growth and Rates of Nitrogen Fertilization

Source of Variance	d.f.	Sum of Squares	Mean Square	F-Value
Total	74	1,092.4928		
Nitrogen	4	354.2101	88.5525	158.90**
Cutting	4	588.1768	147.0442	263.85**
Variety	2	37.5032	18.7516	33.65**
N x C	16	79.6126	4.9758	8.93*
N x V	8	7.1390	0.8924	1.60
C x V	8	8.0168	1.0021	1.80
Residual	32	17.8338	0.5573	

*Significant at $P < .05$.
**Significant at $P < .01$.

TABLE 3a.—Analysis of Variance for Crude Fiber Content of Sudan and Mill Forages at Different Stages of Growth and Rates of Nitrogen Fertilization

Source of Variance	d.f.	Sum of Squares	Mean Square	F-Value
Total	74	1,416.6659		
Nitrogen	4	36.1419	9.0355	4.53**
Cutting	4	974.0366	243.5091	122.02**
Variety	2	67.3251	33.6625	16.87**
N x C	16	126.5274	7.9080	3.96**
N x V	8	22.2969	2.7871	1.40
C x V	8	126.4742	15.8093	7.92**
Residual	32	63.8638	1.9957	

**Significant at $P < .01$.

TABLE 4a.—Analysis of Variance for Dry Matter Content of Sudan and Millet Forages at Different Stages of Growth and Rates of Nitrogen Fertilization

Source of Variance	d.f.	Sum of Squares	Mean Square	F-Value
Total	74	2,653.3718		
Nitrogen	4	34.8935	8.7234	4.22**
Cutting	4	2,343.4524	585.8631	283.60**
Variety	2	57.5407	28.7703	13.93**
N x C	16	88.1417	5.5089	2.67
N x V	8	19.5679	2.4460	1.18
C x V	8	43.6691	5.4586	2.64
Residual	32	66.1065	2.0658	

**Significant at $P < .01$.

TABLE 5a.—Analysis of Variance for Nitrogen-Free Extract Content of Sudan and Millet Forages at Different Stages of Growth and Rates of Nitrogen Fertilization

Source of Variance	d.f.	Sum of Squares	Mean Square	F-Value
Total	74	1,203.0339		
Nitrogen	4	77.8766	19.4691	6.44**
Cutting	4	535.1459	133.7865	44.22**
Variety	2	121.9595	60.9797	20.16**
N x C	16	172.9882	10.8086	3.57**
N x V	8	23.8499	2.9812	<1
C x V	8	174.4565	21.8071	7.21**
Residual	32	96.8073	3.0252	

**Significant at $P < .01$.

TABLE 6a.—Analysis of Variance for Ether Extract Content of Sudan and Mille Forages at Different Stages of Growth and Rates of Nitrogen Fertilization

Source of Variance	d.f.	Sum of Squares	Mean Square	F-Value
Total	74	20.8259		
Nitrogen	4	1.3712	0.3428	2.56
Cutting	4	5.3379	1.3345	9.95**
Variety	2	5.0699	2.5349	18.90**
N x C	16	2.3301	0.1456	1.09
N x V	8	1.4568	0.1821	1.36
C x V	8	0.9701	0.1213	<1
Residual	32	4.2899	0.1341	

**Significant at P < .01.

TABLE 7a.—Analysis of Variance for Ash Content of Sudan and Millet Forages a Different Stages of Growth and Rates of Nitrogen Fertilization

Source of Variance	d.f.	Sum of Squares	Mean Square	F-Value
Total	74	486.6115		
Nitrogen	4	32.3515	8.0879	7.85**
Cutting	4	327.5075	81.8769	79.47**
Variety	2	24.3135	12.1567	11.80**
N x C	16	35.6925	2.2308	2.17*
N x V	8	12.8305	1.6038	1.56
C x V	8	20.9465	2.6183	2.54*
Residual	32	32.9695	1.0303	

*Significant at P < .05.
**Significant at P < .01.

TABLE 9a.—Analysis of Variance for Silage Yield of Sudan and Millet Forages with Varying Rates of Nitrogen

Source of Variance	d.f.	Sum of Squares	Mean Square	F-Value
Total	59	15,254.97		
Blocks	3	200.20	66.733	2.762
Treatment				
Nitrogen	4	7,291.43	1,822.857	12.002**
Variety	2	5,533.56	2,766.780	18.217**
N x V	8	1,215.03	151.879	6.286**
Error	42	1,014.75	24.161	

**Significant at $P < .01$.

TABLE 10a.—Duncan's Multiple Range Test on Silage Yields in Tons per Acre of Sudan and Millet Forages with Varying Rates of Nitrogen

Rate of Nitrogen (Lb./Acre)	Tift Sudan		Common Millet		Gahi—1 Millet	
	Tons	Stat.[1] Sig.	Tons	Stat. Sig.	Tons	Stat. Sig.
0	5.96	a	7.13	a	8.93	ab
30	7.36	a	8.90	ab	15.08	de
60	9.44	abc	14.70	de	21.41	f
120	12.12	bcd	16.04	e	24.46	f
240	12.34	cd	21.08	f	29.25	g

[1] Stat. Sig. means statistical significance. Means followed by letter "a" are significantly different from those means not having "a"; those followed by "b" are significantly different from those not having "b", etc.

TABLE 8A.—Duncan's Multiple Range Test on the Average Composition of the Forages as Affected by Cutting and Nitrogen Treatments

Treatment	Lignin		Crude Protein		Crude Fiber		Dry Matter		N.F.E.		Ether Extract		Ash	
	%	Stat. Sig.[1]	%	Stat. Sig.	%	Stat. Sig.	%	Stat. Sig.	%	Stat. Sig.	%	Stat. Sig.	%	Stat. Sig.
Cutting														
First	3.23	a	13.1	a	25.4	a	11.6	a	46.1	a	2.7	a	12.8	a
Second	3.95	b	12.5	b	28.4	b	14.3	b	43.5	b	2.6	a	13.0	a
Third	5.38	c	10.3	c	33.5	c	17.3	c	43.7	b	2.2	b	10.1	b
Fourth	5.62	c	7.3	d	34.8	d	21.2	d	46.7	a	2.2	b	8.9	c
Fifth	6.72	d	5.9	e	33.5	c	27.6	e	50.9	c	2.0	b	7.7	d
Nitrogen (lb./acre)														
0	4.87	a	7.4	a	32.0	a	19.5	a	47.2	a	2.1	a	11.2	a
30	5.20	a	8.0	b	31.8	ab	18.8	ab	46.7	ab	2.2	a	11.2	a
60	4.91	a	9.5	c	30.9	b	18.0	bc	46.9	ab	2.4	a	10.3	b
120	4.97	a	10.8	d	30.9	b	17.5	c	45.7	bc	2.5	a	10.2	bc
240	5.63	b	13.5	e	30.1	c	18.4	bc	44.4	c	2.4	a	9.5	c

[1] Stat. Sig. means statistical significance. Mean followed by letter "a" is significantly different from those not having "a"; those followed by "b" are significantly different from those not having "b", etc.

TABLE 11a.—Correlation Coefficients Between Certain Constituents in Sudan and Millet Forages

Line on Analysis of Variance Table	Correlation Coefficient					
	Lignin and Crude Protein	Lignin and Crude Fiber	Lignin and Dry Matter	Crude Protein and Crude Fiber	Crude Protein and Dry Matter	Crude Fiber and Dry Matter
Total	—.555**	.770**	.791**	—.665**	—.741**	.581**
Nitrogen	.739	—.629	—.051	—.970**	—.558	.676
Cutting	—.975**	.941	.946**	—.849*	—.972**	.789
Variety	—.317	—.634	.997**	—.532	—.239	.695
Residual	.078	.552**	.142	—.390*	—.109	.096

*Significant at $P < .05$.
**Significant at $P < .01$.

REFERENCES

(1) Adams, G. A., and Castagne, A. E. Determination of Lignin in Cereal Straws. *Can. J. Res. B* 27:915. 1949.

(2) Anderson, K. L., Krenzin, R. E., and Hide, J. D. The Effect of Nitrogen Fertilizer on Bromegrass in Kansas. *J. Am. Soc. Agron.* 38:1058-1067. 1946.

(3) Archibald, J. G., Nelson, P. R., and Bennett, E. A Three-year Study of the Chemical Composition of Grass from Plots Fertilized and Grazed Intensively. *J. Agr. Res.* 45:627. 1932.

(4) Armitage, E. R., Ashworth, R. de B., and Ferguson, W. S. The Determination of Lignin in Plant Materials of High Protein Content. *J. Soc. Chem. Indus.* 67:241. 1948.

(5) Armstrong, D. G., Cook, H., and Thomas, B. The Lignin and Cellulose Contents of Certain Grass Species at Different Stages of Growth. *J. Agr. Sci.* 40:93. 1950.

(6) Association of Official Agricultural Chemists. *Methods of Analysis.* 7th ed. Washington, D. C. 1950.

(7) Bennett, E. Observations on the Development of Certain Wall Constituents of Forage Plants. *Plant Physiol.* 15:327. 1940.

(8) Bird, J. N. Stages of Cutting Studies. I. Grasses. *J. Am. Soc. Agron.* 35:845. 1943.

(9) Brauns, F. E. *The Chemistry of Lignin.* Academic Publ. Co., New York. 1952.

(10) Broyles, K. R., and Fribourg, H. A. Nitrogen Fertilization and Cutting Management of Sudangrass and Millets. *Agron. J.* 51:277. 1959.

(11) Brune, H., and Sieck, K. H. Estimation of Lignin. *Ztschr. Tierernahrung Futtermittelk* 11:253. 1956. (Nutrition Abstr. and Rev. 27:29. 1957.)

(12) Burleson, C. A., Cowley, W. R., and Otey, G. Effect of Nitrogen Fertilizer on Yield and Protein Content of Grain Sorghum in the Lower Rio Grande Valley of Texas. *Agron. J.* 48:524. 1956.

(13) Burton, G. W., and Devane, E. H. Effect of Rate and Method of Applying Different Sources of Nitrogen upon the Yield and Chemical Composition of Bermuda Grass, *Cynodon dactylon* (L.) *Pers.*, Hay. *Agron. J.* 44:128. 1952.

(14) Burton, G. W., Southwell, B. L., and Johnson, Jr., J. C. The Palatability of Bermudagrass (*Cynodon dactylon* (L.) Pers.) as Influenced by Nitrogen Level and Age. *Agron. J.* 48:360. 1956.

(15) Capen, R. G., and Leclerc, J. A. Chemical Composition of Native Alaskan Hays Harvested at Different Periods of Growth. *J. Agr. Res.* 46:665. 1933.

(16) Carey, B., Mitchell, H. L., and Anderson, K. The Effect of Nitrogen Fertilization on the Chemical Composition of Bromegrass. *Agron. J.* 44:467. 1952.

(17) Cooper, C. S. The Effect of Source, Rate, and Time of Nitroge Application upon the Yield, Vegetative Composition and Crud Protein of a Native Flood-Meadow Hay in Eastern Orego *Agron. J.* 48:543. 1956.

(18) Cooper, C. S. The Effect of Time and Height of Cutting o Yield, Crude Protein Content and Vegetative Composition of Native Flood-Meadow Hay in Eastern Oregon. *Agron. J.* 48:257 1956.

(19) Cragmiles, J. P., Baird, D. M., and McCullough, M. E. Qualit Evaluation of Sudan Grass and Millet Forage. *Ga. Agr. Exp Sta. Mimeo. Ser. N. S.* 48:. 1958.

(20) Crampton, E. W., and Forshaw, R. P. Pasture Studies XV. Th Intraseasonal Changes in the Nutritive Value of Pasture Herbag *Sci. Agr.* 19:701. 1939.

(21) Crampton, E W., and Forshaw, R. P. Pasture Studies XVI. Th Nutritive Value of Kentucky Bluegrass, Red Top and Brom grass, with Particular Reference to the Relation Between Chemical Composition of the Herbage and Live Weight Gains by th Animals Subsisting Thereon. *J. Nutrition* 19:161. 1940.

(22) Crampton, E. W., and Maynard, L. A., The Relation of Cellulos and Lignin Content to the Nutritive Value of Animal Feed *J. Nutrition* 15:383. 1938.

(23) Cross, C. J., Beavan, E. J., and Beadle, C. *Cellulose,* pp. 177-18 Longmans, Green & Co., London. 1916 (from Phillips, 78.)

(24) Curtis, O. D., and Ellzey, H. D. Effect of Rates of Nitrogen o the Forage and Protein Production of Several Winter Growin Annuals. *Proc. So. Agr. Workers.* 3rd Conv. P. 69. 1956.

(25) Davis, R. E., and Miller, C. C. Partition of the Less Easily Digested Carbohydrate Complex of Forages. *Indus. Eng. Chem Anal. ed.* 11:651. 1939.

(26) Drapala, W. J., Raymond, L. C., and Crampton, E. W. Pastur Studies. XXVII. The Effect of Maturity of Plant and Its Signification and Subsequent Digestibility by Animals as Indicated b Methods of Plant Histology. *Sci. Agr.* 27:36. 1947.

(27) Duncan, D. B. Multiple Range and Multiple F-Tests. *Biometric* 11:1. 1955.

(28) Eheart, J. F., and Ellett, W. B. The Effect of Certain Nitrogenous Fertilizers on the Chemical and Vegetative Compositio and Yield of Pasture Plants. *Va. Agr. Expt. Sta. Bull.* 75. 1941.

(29) Ellis, G. H., Matrone, G., and Maynard, L. A. A 72-Percen Sulfuric Acid Method for the Determination of Lignin and It Use in Animal Nutrition Studies. *J. Animal Sci.* 5:285. 1946.

(30) Ely, R. E., Kane, E. A., Jacobson, W. C., and Moore, L. A. Studie of the Composition of Lignin Isolated from Orchard Grass Ha Cut at 4 Stages of Maturity and from their Corresponding Feces *J. Dairy Sci.* 36:346. 1953.

(31) Euler, A. C. von. *Cellulosechemie* 2:128. 1921; 3:1. 1922. (from Phillips, 75.)

(32) Featherstone, J., Richaby, C. D., and Cavell, A. J. Variations in the Progressive Yield and Composition of Grassland Herbage During a Period of Three Months Growth. *J. Brit. Grassland Soc.* 6:161. 1951.

(33) Forbes, R. M., and Garrigus, W. P. Application of the Lignin-Ratio Technique to the Determination of the Nutrient Intake of Grazing Animals. *J. Animal Sci.* 7:373. 1948.

(34) Forbes, R. M., and Garrigus, W. P. Some Relationships Between Chemical Composition, Nutritive Value and Intake of Forages Grazed by Steers and Wethers. *J. Animal Sci.* 9:354. 1950.

(35) Fraps, G. S., and Fudge, J. F. The Chemical Composition of Forage Grasses of East Texas Timber Company. *Tex. Agr. Expt. Sta. Bull.* 582. 1940.

(36) Fuchs, W. M. *Biochem. Ztschr.* 192:165. 1928. (from Phillips, 75.)

(37) Glagoleva, T. A. Chemical Composition of Different Grasses at Different Stages of Vegetation. *Dokl. Vses. Akad. Selskohoz. Nauk.* 23:11. 1958. *(Nutrition Abstr. and Rev.* 28:1043. 1958.)

(38) Gortner, R. A. *Outlines of Biochemistry.* 3rd ed. John Wiley and Son, Inc. New York. 1949.

(39) Gray, F. V. The Digestion of Cellulose by Sheep. The Extent of Cellulose Digestion at Successive Levels of the Alimentary Tract. *J. Exptl. Biol.* 24:15. 1947.

(40) Green, A. G. *Ztschr. Farben. Textilchemie* 3:97. 1904. (from Phillips, 78.)

(41) Harris, E. E. A Review. Progress in the Chemistry of Lignin, 1943 to 1954. *Tappi* 38: 179A. 1955.

(42) Heinrichs, D. L., and Carson, R. B. Chemical Composition of Nine Grasses at Six Stages of Development. *Can. J. Agr. Sci.* 36:95. 1956.

(43) Holmes, W. The Intensive Production of Herbage for Crop-Drying. II. A Study on the Effect of Massive Dressing of Nitrogen Fertilizer and of Time of their Application on the Yield, Chemical and Botanical Composition of Two Grass Leys. *J. Agr. Sci.* 39:128. 1949.

(44) Holmes, W. The Intensive Production of Herbage for Crop-Drying. IV. The Effect of Massive Application of Nitrogen, With and Without Phosphate and Potash on the Yield of Grassland Herbage. *J. Agr. Sci.* 41:70. 1951.

(45) Holmes, W., and MacLusky, D. S. The Intensive Production of Herbage for Crop-Drying. V. Effect of Continued Massive Application of Nitrogen, With and Without Phosphate and Potash on the Yield of Grassland Herbage. *J. Agr. Sci.* 45:129. 1954.

(46) Hopper, T. H., and Nesbitt, L. L. Chemical Composition Some Dakota Pasture and Hay Grasses. *N. D. Agr. Expt. S* *Bull.* 236. 1930.

(47) Kamstra, L. D., Moxon, A. L., and Bentley, O. G. Effect of Sta of Maturity and Signification on the Digestion of Cellulose Forage Plants by Rumen Microorganisms in Vitry. *J. Anin* *Sci.* 17:199. 1958.

(48) Kik, M. C. Nutritive Studies of Forage Plants. *Ark. Agr. Ex* *Sta. Bull.* 434. 1943.

(49) Klason, P. *Svensk. Kem. Tid.* 9:133. 1897. (From Brauns, 9.)

(50) Klason, P. *Arkiv. Kemi. Mineral Geol. Bd.* 6:21. 1917. (Fr Gortner, 38.)

(51) Knox, F. E., Burton, G. W., and Baird, D. M. Effect of Nitrog Rate and Clipping Frequency Upon Lignin Content and Diges bility of Coastal Bermuda Grass. *J. Agr. Food Chem.* 6:217. 19

(52) Kuppers, J. R., Rusoff, L. L., and Seath, D. M. Seasonal Var tion of Carotene and Other Nutritionally Important Constitue in Two Pasture Grasses, Dallis and Carpet. *J. Agr. Res.* 77: 1948.

(53) Kurschner, K., and Schramek, W. *Tech. Chem. Papier-Fellst* *Fabr.* 29:35. 1932 (From Gortner, 38.)

(54) Lancaster, R. J. Metabolism Trials with New Zealand Feedi Stuffs. IV. The Relative Significance of Lignin, Cellulose a Crude Fiber in the Evaluation of Foods. *N. Z. J. Sci. Tech.* 21:137. 1943.

(55) Lewis, R. D., and Lang, R. L. Effect of Nitrogen on Yield of F age of Eight Grasses Grown in High Altitude Meadows in W oming. *Agron. J.* 49:332. 1957.

(56) MacDougall, D. The Determination of Lignin in Plant Tissu Use of a Continuous-extraction Method to Remove Interferi Materials. *J. Sci. Food Agr.* 5:103. 1954.

(57) Maynard, L. A. Nitrogen in Animal Nutrition. *Assoc. Offic* *Agric. Chemists* J. 23:156. 1940.

(58) Meyers, J. H., and Lofgreen, G. P. The Estimation of the To Digestible Nutrients in Alfalfa from its Lignin and Fiber C tent. *J. Animal Sci.* 15:543. 1956.

(59) Meyers, J. H., Weir, W. C., Jones, L. G., and Hull, J. L. T Influence of Stage of Maturity on the Feeding Value of Oats H *J. Animal Sci.* 16:623. 1957.

(60) Mondart, C. L., and Owen, C. R. Tests with Species, Varieti and Strains of Forage Crops for Pasture and Hay Production Baton Rouge, Louisiana: Rate of Nitrogen on Sudangrass a Millet. Report of Projects. *Louisiana Agr. Expt. Sta.* 1957.

(61) Moon, F. E., and Abou-Raya, A. K. The Lignin Fraction of A mal Feeding-stuffs. I. Preliminary Examination of Lignin I termination Procedures. *J. Sci. Food Agr.* 3:399. 1952.

(62) Moon, F. E., and Abou-Raya, A. K. The Lignin Fraction of Animal Feeding-stuffs. II. Investigation of Lignin Determination Procedures and Development of a Method for "Acid-insoluble Lignin." *J. Sci. Food Agr.* 3:407. 1952.

(63) Moon, F. E., and Abou-Raya, A. K. The Lignin Fraction of Animal Feeding-stuffs. III. The Determination of "Total Lignin." *J. Sci. Food Agr.* 3:595. 1952.

(64) Morrison, F. B. *Feeds and Feeding.* 22nd ed. Morrison Publ. Co., Ithaca, N. Y. 1956.

(65) Mortimer, G. B., and Ahlgren, H. L. Influence of Fertilization, Irrigation and Stage and Height of Cutting on Yield and Composition of Kentucky Bluegrass. *J. Am. Soc. Agron.* 28:515. 1936.

(66) Munsell, R. I., and Brown, B. A. The Nitrogen Content of Grasses as Influenced by Kind, Frequency of Application and Amount of Nitrogenous Fertilizer. *J. Am. Soc. Agron.* 31:388. 1939.

(67) Neller, J. R. Factors Affecting the Composition of Everglades Grasses and Legumes with Special Reference to Proteins and Minerals. *Fla. Agr. Expt. Sta. Bull.* 403. 1944.

(68) Norman, A. G. A Preliminary Investigation on the Development of Structural Constituents in the Barley Plant. *J. Agr. Sci.* 23:216. 1933.

(69) Norman, A. G. The Composition of Forage Crops. I. Ryegrass (Western Wolths). *Biochem. J.* 30:1354. 1936.

(70) Norman, A. G. The Composition of Forage Crops. III. Cocksfoot Changes in the Herbage During Growth with and without the Addition of Nitrogenous Fertilizer. *Biochem. J.* 33:1201. 1939.

(71) Norman, A. G. Biochemical Approach to Grass Problems. *J. Am. Soc. Agron.* 31:751. 1939.

(72) Norman, A. G., and Jenkins, S. H. The Determination of Lignin. I. Errors Introduced by the Presence of Certain Carbohydrates. *Biochem. J.* 28:2147. 1934.

(73) Norman, A. G., and Jenkins, S. H. The Determination of Lignin. II. Errors Introduced by the Presence of Proteins. *Biochem. J.* 28:2160. 1934.

(74) Norman, A. G., and Richardson, H. L. The Composition of Forage Crops. II. Ryegrass (Western Wolths). Change in Herbage and Soil During Growth. *Biochem. J.* 31:1556. 1937.

(75) Patton, A. R. Seasonal Changes in the Lignin and Cellulose Content of Some Montana Grasses. *J. Animal Sci.* 2:59. 1943.

(76) Patton, A. R., and Gieseker, L. Seasonal Changes in the Lignin and Cellulose Content of Some Montana Grasses. *J. Animal Sci.* 1:22. 1942.

(77) Pavolini, T. *Industria Chimica* 6:1367. 1936. (From Gortner, 38.)

(78) Phillips, M. The Chemistry of Lignin. *Chem. Rev.* 14:103. 1934.

(79) Phillips, M., Goss, M. J., Davidson, J., Davis, B. L., and Stevens, H. Composition of Various Parts of Oat Plant at Successive Stages of Growth with Special Reference to Formation of Lignin *J. Agr. Res.* 59:319. 1939.

(80) Phillips, M., Davis, B. L., and Weike, H. D. Composition of the Tops and Roots of the Timothy Plant at Successive Stages of Growth. *J. Agr. Res.* 64:533. 1942.

(81) Phillips, M., Goss, M. J., and Weike, H. D. Studies on Lignin in Wheat Straw with Reference to Lodging. *J. Agr. Res.* 43:619 1931.

(82) Phillips, M., and Goss, M. J. Composition of the Leaves and Stalks of Barley at Successive Stages of Growth with Special Reference to Formation of Lignin. *J. Agr. Res.* 51:301. 1935.

(83) Phillips, T. J., and Loughlin, M. E. Composition and Digestible Energy of Hays Fed to Cattle. *J. Agr. Res.* 78:389. 1949.

(84) Phillips, T. J., Sullivan, J. T., Loughlin, M. E., and Sprague V. G. Chemical Composition of Some Forage Grasses. I. Changes with Plant Maturity. *Agron. J.* 46:361. 1954.

(85) Quicke, G. V., and Bentley, O. G. Lignin and Methoxyl Groups as Related to the Decreased Digestibility of Matured Forages *J. Animal Sci.* 18:365. 1959.

(86) Ramage, C. R., Eby, C., Mather, R. E., and Purvis, E. R. Yield and Chemical Composition of Grasses Fertilized Heavily with Nitrogen. *Agron. J.* 50:59. 1958.

(87) Rassow, B., and Eschenderlein, A. *Ztschr, Angew, Chem.* 34:204 1921. (from Phillips, 78.)

(88) Raven, A. M., and Robinson, K. L. Studies in the Determination of the Digestibility of Perennial Ryegrass. I. The Determination of Digestibility and Retention of Nutrients Using a Conventiona Method. *Res. Exp. Rec. Minist. Agric. N. Ireland* 5:53. 1957 (*Nutrition Abstr. and Rev.* 28:285. 1958).

(89) Richards, C. R., and Reid, J. T. The Use of Methoxyl in Forage and Fecal Materials as an Index of the Feeding Value of Forages *J. Dairy Sci.* 35:595. 1952.

(90) Richards, C. R., Weaver, H. G., and Connolly, J. D. Comparison of Methoxyl, Lignin, Crude Fiber and Crude Protein of Forages and Feces as Indirect Indicator on Dry Matter Digestibility. *J Dairy Sci.* 41:956. 1958.

(91) Rodriguez, J. P. Effect of Nitrogen Applications on the Yields and Composition of Forage Crops. *J. Agr. Univ. Puerto Rico* 33:98 1949.

(92) Russel, D. A., Carter, C. R., Johns, D. M., and Chandler, E. K The Effects of Rate of Nitrogen and Frequency of Fertilizer Application on Forage Composition. *Proc. So. Agr. Workers, 56th Conv.* p. 86. 1959.

(93) Salo, M. L. Lignin Studies. II. The Lignin Content and Properties of Lignin in Different Materials. *Maatalonst Ailakusk* 29:202 1957. (*Nutrition Abstr. and Rev.* 29:18. 1959).

(94) Schrauth, W. *Z. Angew. Chem.* 36:149. 1923. (from Gortner, 38.)

(95) Snedecor, G. W. *Statistical Methods.* 5th ed. Iowa State College Press, Ames. 1956.

(96) Sosulske, F. W., Patterson, J. K., and Raw, A. G. The Lignin Content of Grass Strains. *Agron. J.* 52:130. 1960.

(97) Sotola, J. Relation of Maturity to the Nutritive Value of First, Second, and Third Cutting of Irrigated Alfalfa. *J. Agr. Res.* 35:361. 1927.

(98) Sotola, J. The Chemical Composition and Nutritive Value of Cereal Hays as Affected by Plant Maturity. *J. Agr. Res.* 54:399. 1937.

(99) Sotola, J. The Chemical Composition and Apparent Digestibility of Nutrients of Smooth Bromegrass Harvested at Three Stages of Maturity. *J. Agr. Res.* 63:427. 1941.

(100) Stallcup, O. T., Cason, J. L., and Walker, B. J. Influence of Lignin Content of Hay on the Passage of Nutrients Through the Rumen. *Ark. Agr. Expt. Sta. Bull.* 572. 1956.

(101) Steppler, H. A. Pasture Studies XXXI, Lignification Studies with Various Grass Species. *Sci. Agr.* 31:1. 1956.

(102) Sullivan, J. T. Cellulose and Lignin in Forage Grasses and Their Digestion Coefficients. *J. Animal Sci.* 14:710. 1955.

(103) Sullivan, J. T., and Garber, R. J. Chemical Composition of Pasture Plants with Some Reference to the Dietary Needs of Grazing Animals. *Penn. Agr. Expt. Sta. Bull.* 489. 1947.

(104) Sullivan, J. T., Phillips, R. H., Loughlin, M. E., and Sprague, V. G. Chemical Composition of Some Forage Grasses. II. Successive Cuttings During the Growing Season. *Agron. J.* 46:11. 1956.

(105) Swanson, E. W., and Herman, H. A. The Nutritive Value of Korean Lespedeza Protein and the Determination of the Biological Values of Proteins for Growing Dairy Heifers. *Mont. Agr. Sta. Bull.* 372. 1943.

(106) Swanson, E. W., and Herman, H. A. The Digestibility of Korean Lespedeza Hay and Ground Korean Lespedeza Seed for Dairy Heifers. *J. Dairy Sci.* 27:263. 1944.

(107) Thacker, E. A. A Modified Lignin Procedure. *J. Animal Sci.* 13:501. 1954.

(108) Thomas, G., and Armstrong, D. G. A Study of Some Methods at Present Used for the Determination of Lignin. *J. Agr. Sci.* 39:335. 1949.

(109) Thompson, R. D. A Comparison of the Value of Two Varieties of Millet as a Feed for Dairy Cows. *M. S. Thesis, Louisiana State Univ.* 1959.

(110) Vicente-Chandler, J., Silva, S., and Figarella, J. The Management and Utilization of the Forage Crops of Puerto Rico. Univ Puerto Rico. *Agr. Expt. Sta. Bull. 116.* 1953.

(111) Vicente-Chandler, J., Silva, S., and Figarella, J. The Effec of Nitrogen Fertilization and Frequency of Cutting on th Yield and Composition of Three Tropical Grasses. *Agron. J* 51:202. 1959.

(112) Waite, R., and Sastry, K. N. S. The Composition of Timoth and Some Other Grasses During Seasonal Growth. *Empire J Expt. Agr.* 17:179. 1949.

(113) Watkins, W. E., and Kearns, J. V. The Nutritive Value of Various Grasses and Grass-Legume Mixtures. *J. Animal Sci.* 15:153 1956.

(114) Wright, P. A., and Shaw, R. G. A Laboratory Study to Determine the Best Time to Ensile Corn. Sunflowers and Sudangrass. *J. Agr. Res.* 32:321. 1926.

Management of Pine Stands For Straw and Timber Production

Bryant A. Bateman and Walter F. Wilson, Jr.

Bulletin No. 543 **June 1961**

Louisiana State University
and
Agricultural and Mechanical College
Agricultural Experiment Station
Charles W. Upp, Director

TABLE OF CONTENTS

Introduction 3

Experimental Methods 3
  Timber 3
  Straw 4
  Brush Control 5

Timber Production and Growth 5
  Basal Area 5
  Cords of Rough Wood 6
  Board Feet 7
  Advantages of Thinning 9

Straw Yields 10

Factors to Consider When Thinning 11
  Crown Classes 12
  Effect of Tree Crown Size on Growth and Quality 12

Guides for Thinning Pine Managed
  For Both Straw and Timber 16

Harvest Cutting Recommendations 18

Brush Control Recommendations 18

Summary 20

Appendix 21

Management of Pine Stands For Straw and Timber Production

BRYANT A. BATEMAN AND WALTER F. WILSON, JR.*

Introduction

The pine woodlands in southeastern Louisiana are a prized possession, and their continuous production of straw is of vital importance. In fact, many strawberry producers have been unwilling to harvest any pine from their woodlands lest they ruin them for straw production. As a result, the uncut woodlands are overcrowded, mortality is high, and growth of individual trees is slow.

Pine straw is used in commercial strawberry production for mulching in Louisiana. No other material is so well suited for strawberry mulching in the humid climate of this area. The oily pine needles shed water better than other materials and thereby perform the three functions of a mulch better. They keep the berries off the ground and thereby keep them clean and greatly reduce decay, reduce the number of weeds competing with the strawberries, and conserve moisture that is lost without a mulch.

Slash and loblolly pines are the preferred species for strawberry mulch. Longleaf pine straw is not used because it is difficult to place around the plants.

Pine stands managed for timber alone are thinned at short intervals in order to: (1) maintain good growth, (2) utilize trees that would normally die, (3) improve the quality of the stand by removal of the poorer trees, and (4) produce a regular income. A thinning and harvesting system is needed in the strawberry belt that will secure the advantages listed above while maintaining the production of straw.

Experimental Methods

Timber

Twelve plots were established in a 23-year-old stand of mixed loblolly-slash pine at the Fruit and Truck Experiment Station five miles east of Hammond, Louisiana, during the winter of 1947-48. Each plot was two-thirds of an acre in area. The plots were thinned to pre-determined stocking every five years. The first thinning, in the winter of 1947-48, was followed by a second in 1952-53 and by a third in 1957-58.

---

*Professor of Forestry, and Superintendent of Fruit and Truck Experiment Station, respectively.

Basal area was selected as the best unit of measurement for controlling and measuring density of stocking (Fig. 1). Based on thinning practices now used in southern pine, 80, 90, and 100 square feet of basal area per acre were selected for this study. The "low thinning" method was used in selecting trees to cut; the degree of thinning was determined by the basal area set for each plot. In the "low thinning" method, the smaller trees are selected first, then the larger ones are taken as the degree of thinning becomes heavier. Three plots were assigned to each of the three thinning treatments, and three were left unthinned as "checks" or control plots.

At the beginning of the experiment, the trees were measured and given a temporary marking to prevent duplication, but records were not kept on individual trees.

During the winter of 1951-52, each tree was numbered and its position on the plot mapped. Since then, all records have been kept on individual trees. Growth and mortality are discussed more fully for the five-year period between the second and third cuts, because more detailed information is available.

The five-year thinning interval is excellent for intensive management of a pine stand. However, in stands managed for straw and timber production, extra time is required to remove the unused material following a cut. To see if this extra work could be reduced while maintaining a satisfactory straw yield, three additional plots were thinned to approximately 100 trees per acre (average basal area 74 square feet per acre) in the winter of 1951-52. A second thinning here should not be necessary during the next 10 or 15 years.

To check straw production by trees younger than those chosen for study originally, four one-twentieth-acre plots were established in a 17-year-old stand during the winter of 1956-57. These plots have not yet been thinned; future thinnings will be designed to maintain about 40 per cent of the total tree height in live crown.

Straw

Each year between the 12th and the 15th of December, the straw on the center one-fifth acre of each two-thirds acre plot was hand-raked and weighed separately. During wet periods, samples were taken from each plot and air-dried. The weight of each sample was obtained before and after drying so that all straw weights per plot could be calculated on air-dry basis. The straw from each plot was kept separate, and the area it covered when applied as mulch was determined.

Natural stands of young pine timber (12 years old) were checked to determine the approximate age at which commercial straw yields were first produced.

Brush Control

Hardwood brush and blackberry covered most of the better-drained portions of the plots when they were established. Axes, brush knives, and hoes were used to clear the area of brush and briers. Since then, brush and briers have been kept under control with chemicals applied as foliage sprays.

Ammate and mixtures of low-volatile esters of 2,4,5-T and 2,4-D were used at the beginning of the control program. Ammate was applied at three rates: one, two, and four pounds per gallon of water. All of the 2,4,5-T and 2,4-D used contained four pounds of active ingredients per gallon. Concentrations were expressed as a percentage of the total volume of 2,4,5-T or 2,4-D added to the carrier.

Water, varsol, and kerosene were used as carriers for the 2,4,5-T and 2,4-D. Mixtures of one per cent 2,4,5-T, two per cent 2,4,5-T, and one per cent 2,4,5-T plus one per cent 2,4-D, were applied in water. Mixtures of one per cent 2,4,5-T plus one per cent 2,4-D were used in both kerosene and varsol.

Annual checks were made to determine the degree of control obtained. During the last three years, a two per cent solution of 2,4,5-T in water has been the only treatment used.

Timber Production and Growth

The rate of growth of a stand of timber largely determines its future value to the timber owner. Soil texture, structure, and depth, which control water-holding capacity and internal drainage, are the keys to the volume of wood added yearly to a given forest stand under a given set of conditions. The species of trees is another factor that affects growth. Fortunately, most of our southern pines grow satisfactorily on sites that they naturally inhabit. Loblolly and slash pines, which produce most of the straw used in the strawberry belt, both grow rapidly under favorable conditions.

As was stated earlier, basal area was used in this study for control of forest stocking. It is easy to determine and, being directly related to volume, is an acceptable method of expressing growth.

Basal Area

The per-acre annual growth in basal area decreased slightly as the total basal area per acre increased. The annual increase in basal area for each thinning treatment is shown in Table 1.

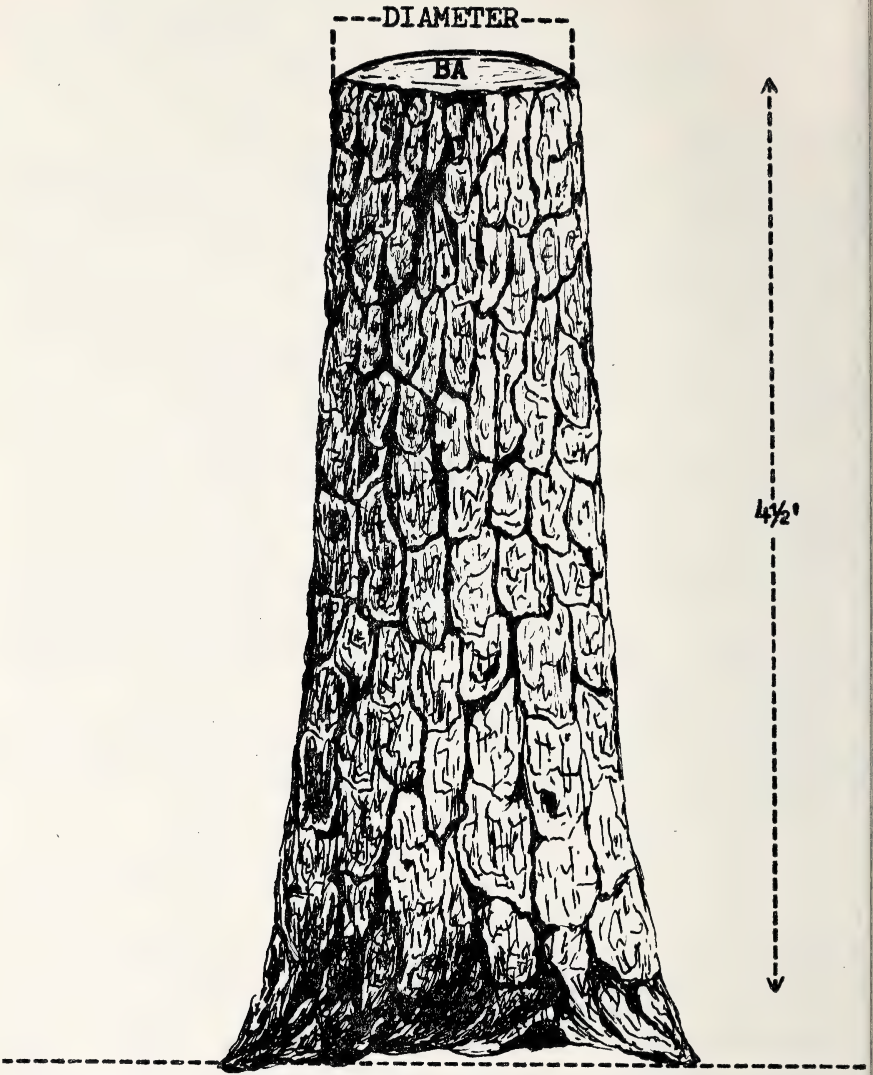


FIGURE 1.—The basal area (B.A.) of a tree is the square surface of a cross-section of the tree 4½ feet above the ground. The diameter is measured at that point and used to determine the cross-section of the tree in square feet.

Table 1 in the Appendix gives the basal area and growth in basal area for each plot.

Cords of Rough (Unpeeled) Wood

The trends of total volume and annual growth in cords differed somewhat from the trend found in basal area. Annual growth in

TABLE 1.—Annual Increase in Basal Area Per Acre, by Thinning Treatments, 1948-1958

Basal area per acre at beginning of period (1948) (square feet)	Annual increase during 5-year period 1948-53 after first thinning (square feet)	Annual increase during 5-year period 1953-58 after second thinning (square feet)
74 (100 trees per acre)	(only one thinning)	3.7
80	4.4	3.9
90	3.4	3.7
100	3.3	3.6
117 (check)	2.0	2.2

cords was approximately equal among thinned plots and was greater on thinned plots than on the checks. The percentage gain based on the volume at the beginning of the period was highest on plots thinned heaviest. It decreased as basal area and volume per acre increased.

Table 2 shows the increase in rough cords per acre between the second and third thinnings, which were made at ages 28 and 33 respectively. In addition, the percentage increase for each of the various treatments is given.

TABLE 2.—Annual Increase in Rough Cords Per Acre and Per Cent Increase Annually Between Second and Third Thinnings, by Treatments

Basal area per acre at beginning of period (1953) (square feet)	Annual increase during 5-year period 1953-58 after second thinning (cords)	Annual increase during 5-year period 1953-58 after second thinning (per cent)
74 (100 trees per acre)	1.67	4.98
80	1.73	4.92
90	1.77	4.69
100	1.86	4.36
127 (check)	1.30	2.46

Table 2 in the Appendix gives the cordwood volume and growth for each plot.

Board Feet

The board-foot volume growth of an acre of timber does not follow the exact pattern of basal area growth or cordwood growth. The board-foot volume of individual trees increases rapidly as diameter increases. The cordwood volume of a 16-inch tree was 2.6 times as great as that of a 10-inch tree in this study; the board-foot volume (International ¼" scale[1]) was 4.5 times as great for trees with the same diameters. If Doyle log scale is used, the volume in board feet of the 16-inch trees is 7.4 times as great as that of the 10-inch trees.

---

[1] The International ¼" board-foot rule is preferred in research work. It gives very nearly the actual amount of lumber that can be sawed from sound logs with efficient mill operation. The Doyle scale gives volumes far too low for small logs.

Another complicating factor enters into this study. By chance, one of the three check plots, Number 5, was more productive than any of the other original plots. It occupied the most moist site; it had more large, and fewer total trees than the average of other plots. At the time of the second thinning, this plot had 27 trees 13.6 or more inches in diameter at breast height. There were 61 trees 11.6 or more inches. The next highest plots in these two tree diameter classes had 22 and 49 trees respectively. The average for the nine thinned plots was 13 trees per acre 13.6 inches and above; there was an average of 33 trees 11.6 inches and above. The per-acre volume of plot Number 5 at the third thinning was 14,200 board feet in trees 13.6 inches and above, International ¼" scale. The check plot with the greatest number of trees and a basal area approximately equal to that of plot Number 5 had only 1,123 board feet per acre in trees 13.6 inches and above.

In young stands, the number of trees that grow into the sawtimber diameter classes (ingrowth) is another factor that affects the annual growth in board-foot volume. If 12-inch trees (11.6 inches and up) are considered the lowest diameter class that can be profitably cut into lumber, then the number of such trees after a five-year period will frequently be greater than at the beginning of the period. Thus, some of the volume considered "growth" was actually present five years earlier in trees less than the minimum diameter set for sawtimber.

The average volumes per acre in trees 11.6 inches and up by the International ¼" scale and the average annual growth per acre by basal area groups are shown in Table 3.

TABLE 3.—Average Volume Per Acre and Average Annual Growth in Volume Per Acre, Trees 11.6 Inches and Larger DBH, By Basal Area Groups

Basal area per acre beginning of period—age 28 (1953) (square feet)	Volume per acre before third thinning—age 33 (1958) (board feet)	Annual increase during 5-year period between second and third thinning (board feet)
74 (100 trees per acre)	13,130 (only one thinning)	1,329
80	13,509	1,063
90	12,915	1,142
100	13,178	1,326
127 (check)	12,437	976

Table 3 in the Appendix gives the board-foot volume and growth for each plot.

Advantages of Thinning

The four advantages of thinning outlined previously are being realized on the experimental plots.

First, *growth* in total wood volume is greater on the thinned plots than on the unthinned plots. However, the original stand did not have an evenly distributed, even-aged composition. Scattered through the stand were old seed trees left from an earlier cut. Several such trees were found on some plots while others had none. Some plots had very thick stands while others were more open. The live crowns (all living limbs) on the trees in a thick stand are smaller than those of trees where there is less crowding. When stands of thick trees and stands of more open-grown trees are both thinned to the same basal area, the live crowns of trees are smaller where the original stand was thicker. One result of this uneven stocking found in the check plots has been mentioned. However, thinning has been followed by faster growth on the trees left. Thinned stands reach sawlog size sooner than unthinned stands. The value of large sawtimber of high quality ordinarily is three to five times greater than that of the same volume sold for pulpwood. In addition, 1,000 board feet in 16-inch trees is usually about four times as valuable for lumber production as 1,000 board feet in 12-inch trees.

Second, *mortality*, or death of trees from crowding, did not occur on the more heavily thinned plots. On the densest check plot, 120 trees died during the first five years and 27 died during the second five years. The more open check plot (Number 5) lost 65 trees during the first five years and 27 during the second five years. Most of the trees that died were large enough for posts or pulpwood.

Third, the *quality* of the trees remaining in the thinned plots is much higher than the average of those in the check plots. Nearly all trees infected with canker (fusiform rust caused by *Cronartium fusiforme*) have been removed by thinning. Crooked, forked, rough, and injured trees were also removed in the thinnings. It has been necessary for suitable straw production to keep a few poor trees on the thinned plots, but the overall quality is much higher than on the unthinned plots.

Fourth, an *income* has been obtained from three thinnings over a 10-year period. The average volume of cut for the three thinnings was 21.8 cords per acre. At the going rate for pulpwood stumpage, $4.00 per cord, the total value of stumpage sold from the woodland was $87.20 per acre. If the wood had been cut and delivered to the railroad or to the mill, the value would have been considerably greater. This represents an interim income, which was obtained at little cost to the owner and has left the volume of growing stock substantially intact but has increased its value.

Straw Yields

The amount of straw produced on the original plots increased as basal area increased. The unthinned plots produced more than the thinned plots, although the difference was relatively small. Several factors entered into the overall weight of the straw produced. Where some plots had a very heavy growth of grass, the straw could not be raked clean and a considerable amount of grass was included. Other plots had very little grass and all straw could be raked. Check plot Number 5 had very little grass, and rain water drained into it. Following heavy rains, straw floated onto this plot from the outside. However, the amount of outside straw is not considered to affect the results significantly.

The average straw yield per acre between the second and third thinnings is shown in Table 4 in pounds of air-dry material.

TABLE 4.—Average Annual Straw Yield Per Acre, 1953-58, by Basal Area Groups

Basal area per acre after second thinning (1953) (square feet)	Average annual yield (pounds)
74 (100 trees per acre)	3,740
80	4,065
90	4,315
100	4,750
127 (check)	5,255

The straw produced by each plot was kept separate after raking and weighing. It was applied to strawberry beds and the length of bed mulched was measured. As with weights, several factors are thought to affect the number of feet of bed covered per pound of straw. They were: relative dryness of straw, the amount of dirt collected by the straw, the amount of grass mixed with the straw, the velocity of the wind at the time of application, and how the men did the work.

Each pound of straw, air-dry weight, mulched an average of 1.3 feet of bed over a four-year test period. Based on this average, the number of acres of pine timber required to mulch one acre of berries when rows were spaced 40 inches apart is shown in Table 5.

TABLE 5.—Number of Acres of Pine Timber Required to Furnish Straw to Mulch One Acre of Strawberries[1], by Basal Area Groups

Basal area per acre (square feet)	Acres of timber required
74 (100 trees per acre)	2.56
80	2.36
90	2.22
100	2.04
127 (check)	1.83

[1] When strawberry rows are 40 inches apart.

Based on all the original plots, approximately two acres of timber at the Fruit and Truck Station experimental area were needed to mulch one acre of strawberries. Most strawberry growers normally have an adequate supply of straw for their needs. When extra straw is required it can be obtained in place, i.e., raked and loaded, by the buyer, at a cost of three to four dollars per acre. This price is set by local supply and demand and does not represent the true value of pine straw to the strawberry grower.

As was noted previously, in the winter of 1956-57 four plots were established in younger stands. The average age (June, 1959) of these stands was 20 years; the average basal area was 136.5 square feet per acre. The average yield of straw collected in December, 1957, and December, 1958, was 9,753 pounds per acre per year. During the same two years the 15 plots having trees 35 years old averaged 4,661 pounds per acre. The straw yield from the younger stands was more than double that of the older stands during those two years. The reason for the high straw yield of the 20-year-old timber is not known. However, the explanation may be that at this age an unthinned stand of pine becomes very crowded and dense. The lower limbs and the smaller trees are shaded and die. This results in a shedding of dead needles from the dead limbs and dead trees. These dead needles are added to the normal annual shedding of needles from the upper parts of the crowns.

In the thick 12-year-old stands checked, all grass had been killed out and straw yields were adequate for use by strawberry growers.

Factors To Consider When Thinning Pine

The rate of growth of an individual tree will depend on several factors. On a given site the most important of these are rainfall, soil type, drainage, and the size of the live crown, which is determined by the number of trees per acre. On a given area, rainfall, soil, and drainage cannot be readily changed by the usual forest management practices. The size of the live crown can be increased by reducing the number of trees in crowded young stands.

The number of trees per acre in an even-aged stand ordinarily has little effect on tree height growth but drastically affects diameter growth. An average diameter growth of three inches in 10 years may be considered satisfactory from both volume and quality standpoints.

Crown Classes

Trees are divided into four classes based on the size of the live crown and the amount of direct light received by the crown (Fig. 2). Dominants are those trees having large crowns that extend above the average level of the forest and receive light on the top and sides. Codominants are the next height group and make up the greatest number of trees in an even-aged stand; they receive light on top and some light on the sides of the crown. The intermediate crown class comes third and includes those trees that are being crowded out and receive direct light on the top of the crown only. The overtopped crown class receives no direct light.

Effect on Growth and Quality of Tree Crown Size

When managing forest trees grown for commercial use, an effort is made to induce early natural pruning to secure a high-quality product clear of knots. At the same time, crown lengths must be maintained that are large enough to provide for good growth. Every limb that grows from the trunk of a tree leaves a knot. The size of the knot is determined by the size of the limb and the period of time it is attached to the tree. As the first two 16-foot logs contain a high percentage of the commercial volume of a tree, limbs on that portion of the tree should never be permitted to grow large or hang on for long periods. Under natural conditions, early pruning is attained by maintaining a large number of stems per acre during the early life of the stand. However, if the stand is left unthinned too long, growth stagnates, mortality is high, and volume may actually decrease over a short period of time. Growth increases again following a heavy natural thinning when many trees die.

The rate of diameter growth of individual trees is largely determined by the live crown that the tree has. The ideal crown is relatively long and well-rounded. Many trees have long, well-developed crowns on one side, but very little or no crown on the opposite side. For convenience, crown length is usually expressed as a fractional part or percentage of the total height of the tree. A crown length of 30 to 40 per cent of the total height of the tree

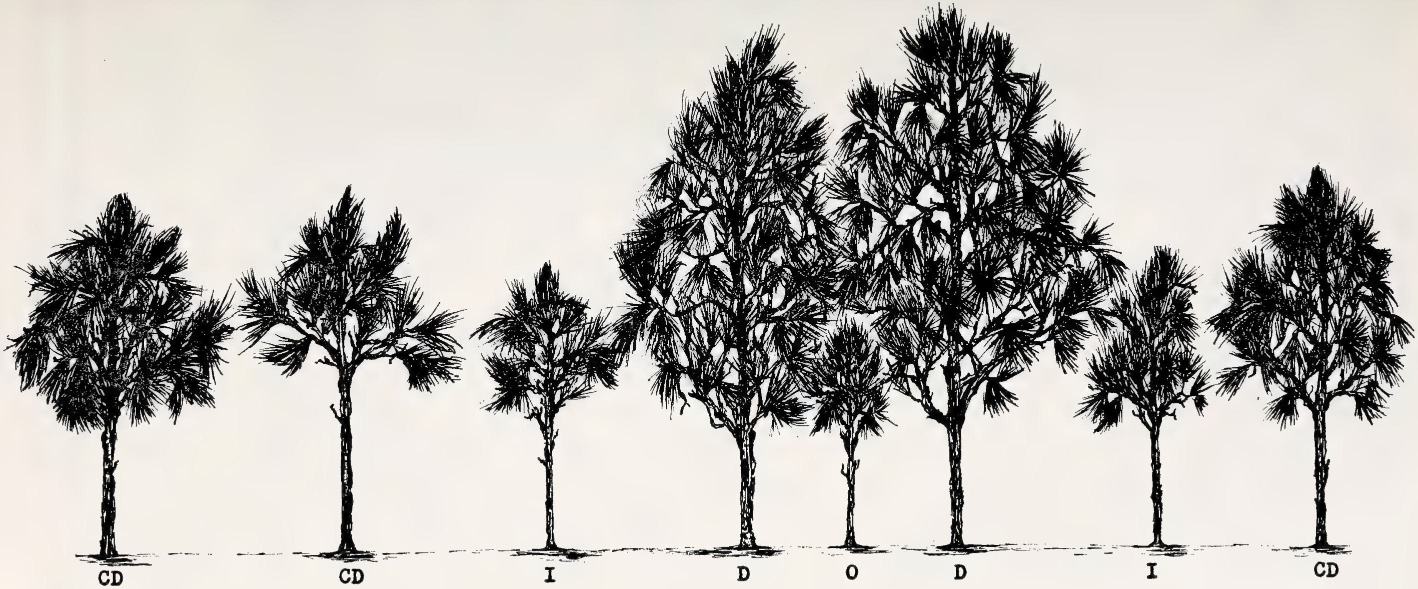


FIGURE 2.—Crown classes in a fully stocked, even-aged stand. Dominants (D), Codominants (CD), Intermediates (I), Overtopped (O).

should enable the tree to maintain satisfactory diameter growth Periodic thinnings should be made in order to maintain this crown length:total-height relationship.

Pine trees make their most rapid growth during early life Height growth slows down after trees are 30 to 35 years of age This fact must be taken into consideration when a stand is thinned A 20-year-old tree with 20 per cent of its total height in live crow will develop into a relatively fast-growing tree if given plenty o growing space. A 40-year-old tree with the same percentage of liv crown may never grow satisfactorily, regardless of the space allowed for growing.

Need and Degree of Thinning

The age at which the first thinning is made in a young pin stand on a given soil type depends on the original stocking. In a 28 year-old pine stand in East Feliciana Parish, one portion of th stand had a low number of trees. The average crown length is no 43 per cent of the total height of the tree. In a heavily stocke portion of the stand, only 27 per cent of the total height is in liv crown and heavy mortality has occurred here. The thin portion o this stand does not yet need thinning; the thick portion should hav been thinned several years earlier.

The live crowns of the trees in the 20-year-old (June, 1959 stand described in the present study range from 35 to 40 per cen of the total height. These stands should be thinned within the nex two years.

Thick young stands with short crowns should be thinned so a to give room for rapid crown spread. The exact open space aroun each crown left should be determined by the planned time interva between thinnings. Use small openings with short intervals and increase the size of the openings as the time between thinnings i increased. In older stands, crown spread will be slower and th thinning precedure should be determined by on-the-spot inspections

Overtopped and small intermediate trees that are not merchantable may be cut if they interfere with straw raking. However, i they show promise of living and growing following a thinning, the may be left until merchantable. They have little or no effect on th growth of dominant and codominant trees.

Large low-quality dominant trees may be retained for stra production, if there are no existing trees of better quality to fil in the space which they occupy.

Fusiform rust is a disease that causes open sores or swelling (cankers) on pine stems and limbs. The canker is caused by spore

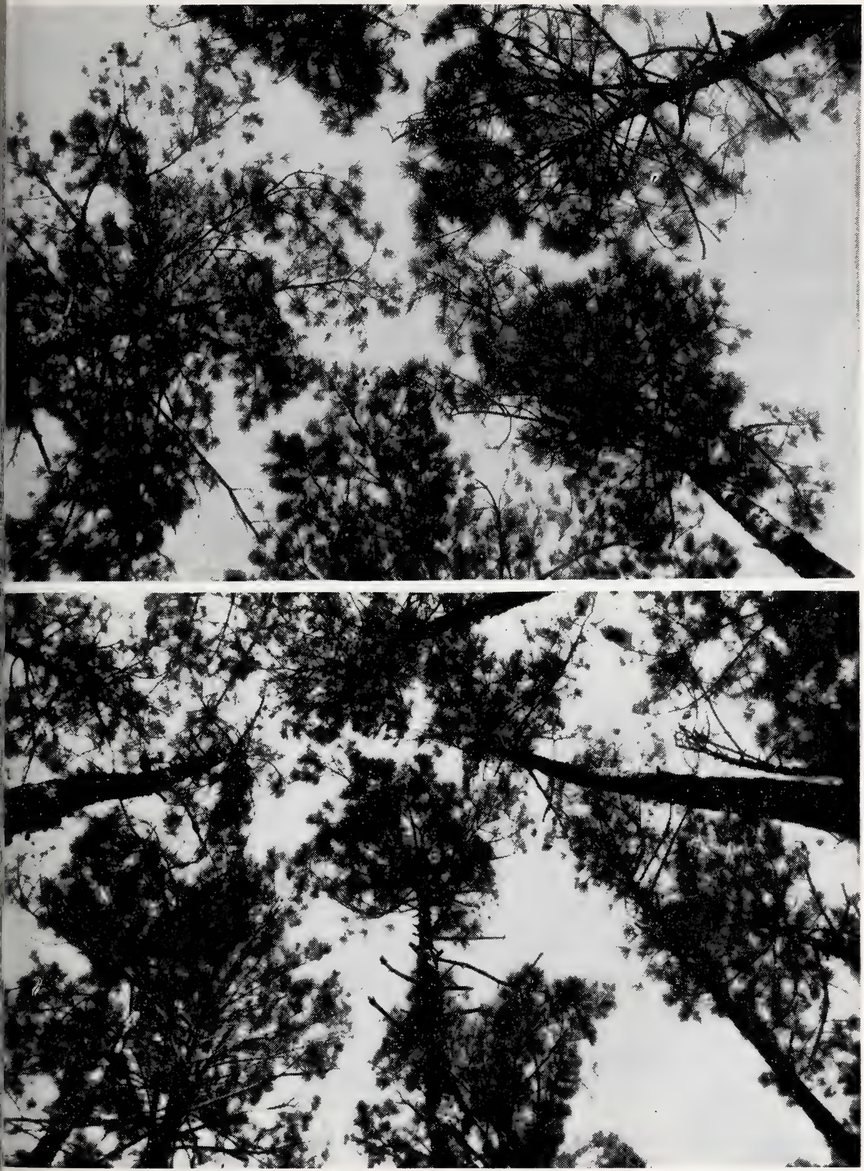


FIGURE 3.—Thinning to 80 square feet of basal area per acre (top hoto) allows crowns to develop sufficiently to support normal growth of imber to sawlog size. Unthinned pines (lower photo) have underdeveloped rowns, resulting in slow growth and low timber production.

roduced on oak leaves in early spring. It cannot be prevented, beause oaks are so widespread. Damage by stem canker is two-fold: (1) it lowers the volume and value of commercial products from trees, and (2) it often causes the trees to break during wind storm Normally, a tree should be removed if a canker covers one-half c more of the circumference of the stem.

Guides for Thinning Pine Managed for Both Straw and Timber Production

The following suggestions for management of pine stands fc both straw and timber production are based on the research r ported in this bulletin, together with the results of research co ducted elsewhere, and the personal observations of the author Recommendations for deciding when a stand should be thinne are made in terms of live-crown ratio rather than in terms c basal area. For most timber owners, live-crown ratio is easier t estimate and to apply than is basal area.

The program below is applicable particularly to stands in south eastern Louisiana. Thinning recommendations are designed to mair tain stand basal area at a minimum of 80 square feet per acr Straw yields will average at least 4,000 pounds (air-dry) per acr The income from the sale of timber removed in thinnings will mor than offset the slight decrease in straw yield resulting from thir ning.

I. In thick young stands:
  A. Thin to maintain 33 to 40 per cent of the total height c codominants in live crown. This should result in 5 to rings per inch of radial growth.
    1. Remove overtopped trees if merchantable.
    2. Remove intermediates if merchantable, unless neede for crop trees.
    3. Remove diseased, crooked, and low-quality codomi nants, unless large holes will be made in the crow canopy.

II. Second and later thinning in stands previously thinned:
  A. Thin to secure even radial growth of wood; maintain live crown on codominants of not less than one-third o the total tree height.
    1. Remove most intermediates.
    2. Remove poor-quality codominants left in first cut, i large openings will not be made.
  B. Thin when the codominants have three 16-foot logs clea of live limbs, even though ⅓ or more of total height is i live crown. Follow rules under *II-A* above.

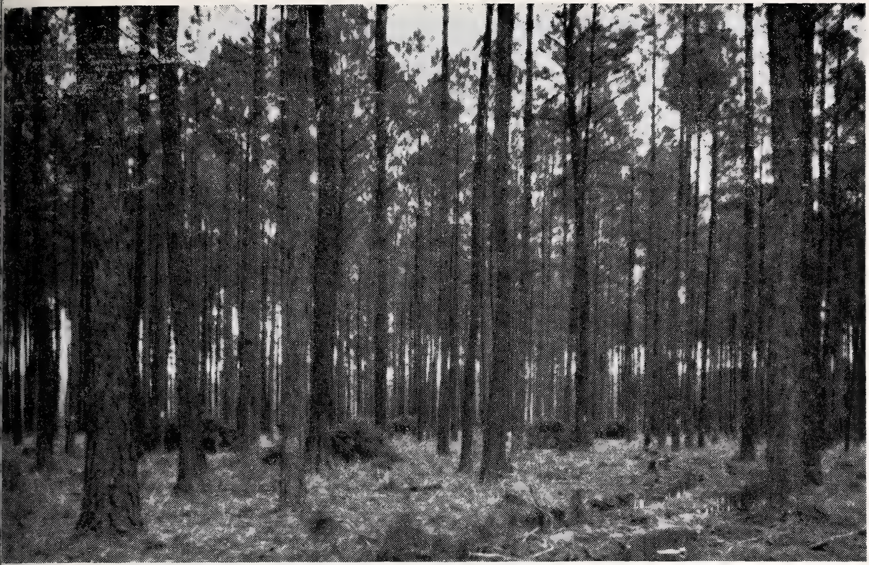


FIGURE 4.—Strawplots after thinning, spring 1958.

C. Thin so as to maintain codominants with nearly 40 per cent of total height in live crown as stands grow older. Openings should be kept relatively small in older stands.

III. In stands that were open or not thick when young:

(If the stand originally had a very low number of trees, the first thinning necessary might be as described in *C*, below.)

- A. Thin when young if canker is present on many trees.
- B. Thin when the live crown of codominants is reduced to 33-40 per cent of the total height of tree.
  1. Remove overtopped trees.
  2. Remove intermediate trees, if not needed for crop trees.
  3. Remove poor-quality codominants, if permanent holes will not be made.
  4. Remove other codominants or dominants where more growing space is needed.
- C. Thin when codominant trees have three 16-foot logs clear of live limbs.
  1. Remove overtopped trees.
  2. Remove intermediate trees if not needed for crop trees.
  3. Remove poor trees in upper crown classes where permanent holes will not be made.
- D. Thin as needed so as to maintain about 40 per cent of total height of codominants in live crown.

Harvest Cutting Recommendations

When straw is a major product of the forest, even-aged management is recommended. Seedling trees within the stand woul greatly interfere with the raking of the straw.

The rotation, or age of trees at the final cut, should be 50 to 6 years, based on species and stand condition. The shelterwood system seems best suited if natural reproduction is desired. It ha three advantages over other methods: (1) Reproduction can b secured more quickly. (2) A partial straw harvest would be possibl until reproduction is established. (3) Hardwood brush would b held in check.

The shelterwood harvest should be a two-stage operation: (1 Remove about 60 per cent of the stems present, leaving the larges high-quality trees to produce seed for reproduction. (2) Remov all remaining trees within two years after a satisfactory stand o reproduction has been established.

Clearcutting followed by artificial reproduction offers some advantages, although it is more expensive than the shelterwood method. Reproduction can be secured quickly and evenly if seedlings ar planted with a 6-foot by 8-foot spacing. Direct seeding with see treated to prevent loss to birds and rodents is now being done successfully.

Brush Control Recommendations

Table 6 is a list of the woody plants on the plots when sprayin began.

TABLE 6.—Woody Plants on Straw Plots

Blackberry
Black cherry
Blackgum
Button bush
Chinquapin
Crabapple
Dogwood
French mulberry
Gallberry
Hickory
Holly
Magnolia
Oak, live
Oak, post
Oak, southern red
Oak, water
Persimmon
Pine
Poison-ivy
Redbay
Red maple
Sassafras
Smilax (saw brier)
Sumac
Summer huckleberry
Sweet bay
Sweetgum
Waxmyrtle
Wild azalea
Winter huckleberry
Yaupon
Yellow jessamine

During the summers of 1958 and 1959, woody vegetation wa so scarce that no treatment was needed. At the time of raking ir

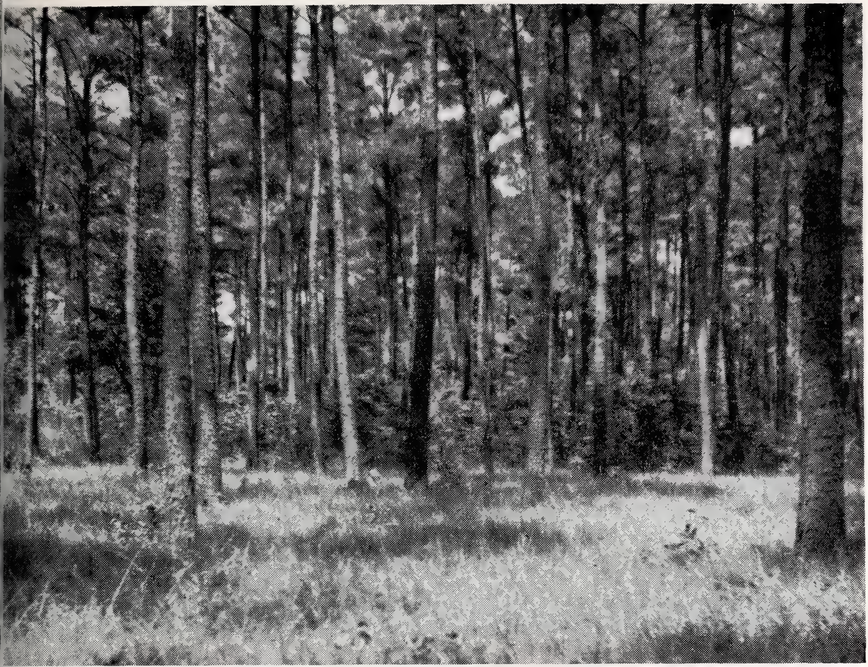


Figure 5.—Strawplots sprayed for brush control in foreground, not sprayed in background.

December, 1959, scattered sprouts under two feet tall were present. Those most common were French mulberry, red oak, water oak, blackgum, smilax, and blackberry.

Brush control is not a one-shot procedure. Several applications may be needed to kill existing brush. Sprouts and root suckers are persistent. In this study, red oak, blackgum, and some other species were four to six inches in diameter when they were first cut. Sprouts from these stumps have been very persistent. The excessive sprouting could have been largely prevented if the newly cut stumps had been covered with ammate crystals or sprayed with a five per cent solution of 2,4,5-T in fuel oil.

The treatments considered best were two pounds of ammate in one gallon of water and two per cent 2,4,5-T in water. One pound of ammate (not the more concentrated type now available) did not kill as completely as the higher concentrations. Four pounds per gallon is too costly to use under most conditions. Solutions with less than 2 per cent 2,4,5-T were less effective than the 2 per cent solution even when 1 per cent 2,4,5-T plus 1 per cent 2,4-D were used. The control obtained with kerosene and varsol was about equal to that obtained with water as carrier and was more expensive.

A solution of 2 per cent 2,4,5-T in water is now the only treatment used on the experimental straw plots. It has one major advantage over ammate. The equipment used in spraying is easil maintained when 2,4,5-T is used; it is almost impossible to preven corrosion when ammate is used.

For new areas, recommendations are: cut brush low and trea stumps immediately with a 5 per cent solution of a low-volatil ester of 2,4,5-T in fuel oil; after clearing, treat as outlined belov For existing straw areas: spray the foliage of woody vegetatio in the spring with one pound of the new type of ammate in on gallon of water or with 2 per cent solution of a low-volatile este of 2,4,5-T in water (active ingredients, four pounds per gallon).

Summary

Timber management practices for the production of both woo products and pine straw were begun on the Louisiana State University Fruit and Truck Experiment Station in southeastern Louisiana in 1947. At the beginning of the experiment, twelve plots wer established in a 23-year-old loblolly pine stand with four thinnin treatments, each treatment being replicated three times.

Basal area was used to measure and control density. Afte thinning, scheduled at five-year intervals beginning in 1947-48, th basal areas of thinned plots were 80, 90, and 100 square feet. I 1952, three additional plots in the same timber type were thinne to 100 trees per acre, which reduced the stocking to an average c 74 square feet of basal area per acre. Four plots in unthinned 17 year-old stands were also checked for straw production.

The nine thinned plots in the original group of twelve have bee thinned three times—first, at the beginning of the study, and th next two times at five-year intervals. The three plots added in 195 have been thinned once.

Basal area growth decreased slightly as per-acre basal area increased. Sawtimber and cordwood growth on thinned plots exceeded growth on unthinned plots. The average volume harveste in the three thinnings was 21.8 cords per acre, valued at $87.20 o the stump.

Straw yields decreased slightly as the per-acre basal area decreased. The 17-year-old stand produced much more straw tha the older plots. Stands at the age of 12 years produced commercia straw yields. Approximately two acres of timber were required t produce sufficient straw to mulch one acre of berries, on the average.

Thinning recommendations were presented which will maintain ong, well-rounded crowns after stems with three logs clear of live imbs have been obtained. This will produce both good growth of high-quality wood and satisfactory straw yields.

Hardwood brush has been controlled with chemicals after the brush was cut at the time of the first thinning. For stumps after arge brush has been cut, it is recommended that a 5 per cent solution of 2,4,5-T (low-volatile ester) in fuel oil be used; for a foliage spray on smaller brush, use a 2 per cent solution of 2,4,5-T (low-volatile ester) in water.

Appendix

APPENDIX TABLE 1.—Basal Areas and Growth on Straw Plots in Square Feet Per Acre

Plot Number	B.A. after thinning 1952-53 (age 28)	B.A. before thinning 1957-58 (age 33)	Growth in 5 years	Annual growth
	Thinned to a pre-determined basal area per acre			
4	80	100.1	20.1	4.0
6	80	96.5	16.5	3.3
9	80	101.6	21.6	4.3
			Average	3.9
2	90	108.7	18.7	3.7
7	90	109.2	19.2	3.8
12	90	107.3	17.4	3.5
			Average	3.7
1	100	119.0	19.0	3.8
8	100	117.1	17.1	3.4
10	100	118.5	18.5	3.7
			Average	3.6
	Checks—not thinned			
3	130.9	141.0	10.1	2.0
5	135.8	145.3	9.5	1.9
11	115.5	128.5	13.0	2.6
			Average	2.2
	Thinned to approximately 100 trees per acre, winter 1951-52			
13	73.8	92.2	18.5	3.7
14	67.6	85.6	18.0	3.6
15	80.8	100.5	19.6	3.9
			Average	3.7

APPENDIX TABLE 2.—Pulpwood Volumes and Growth on Straw Plot in Cords of Rough Wood Per Acre

Plot Number	B.A. after thinning 1952-53 (sq. ft.)	Vol. after thinning 1952-53 (cords)	Vol. before thinning 1957-58 (cords)	Growth in 5 years (cords)	Annual growth (cords)
Thinned to a pre-determined basal area per acre					
4	80	35.8	44.3	8.5	1.7
6	80	34.6	41.6	7.0	1.4
9	80	35.1	45.6	10.5	2.1
Average	80	35.2	43.8	8.7	1.7
2	90	39.7	48.1	8.4	1.7
7	90	38.4	47.4	9.0	1.8
12	90	38.3	47.4	9.1	1.8
Average	90	38.8	47.6	8.8	1.8
1	100	43.1	53.1	10.0	2.0
8	100	42.3	51.2	8.8	1.8
10	100	42.2	51.1	9.0	1.8
Average	100	42.5	51.8	9.3	1.9
Checks—not thinned					
3	130.9	52.6	59.0	6.4	1.3
5	135.8	58.5	63.9	5.3	1.1
11	115.5	47.5	55.4	7.8	1.6
Average	127.4	52.9	59.4	6.5	1.3
Thinned to approximately 100 trees per acre, winter 1951-52					
13	73.8	34.5	41.2	6.6	1.3
14	67.6	29.6	38.5	8.8	1.8
15	80.8	36.1	45.6	9.5	1.9
Average	74.1	33.4	41.8	8.3	1.7

APPENDIX TABLE 3.—Sawtimber Volumes and Growth on Straw Plots in Board Feet Per Acre, International ¼-Inch Rule, Trees 11.6 Inches DBH and Up

Plot Number	B.A. after thinning 1952-53 (sq. ft.)	Vol. after thinning 1952-53 (bd. ft.)	Vol. before thinning 1957-58 (bd. ft.)	Growth in 5 years (bd. ft.)
Thinned to a pre-determined basal area per acre				
4	80	6,645	12,283	5,638
6	80	8,176	10,660	2,484
9	80	9,668	17,498	7,830
Average	80	8,163	13,480	5,317
2	90	11,119	16,813	5,694
7	90	5,700	12,367	6,667
12	90	4,792	9,563	4,771
Average	90	7,204	12,914	5,711
1	100	9,494	17,565	8,071
8	100	5,218	12,468	7,250
10	100	4,925	9,498	4,573
Average	100	6,546	13,177	6,631
Checks—not thinned				
3	130.9	3,266	7,461	4,195
5	135.8	12,815	19,268	6,453
11	115.5	6,586	10,581	3,995
Average	127.4	7,556	12,437	4,881
Thinned to approximately 100 trees per acre, winter 1951-52				
13	73.8	2,797	8,197	5,400
14	67.6	5,843	12,449	6,606
15	80.8	10,817	18,746	7,929
Average	74.1	6,486	13,131	6,645

S67
.E5b

JUNE 1961

BULLETIN NO. 544

NEW MEXICO STATE UNIVERSITY LIBRARY

Optimum Distribution of Producer Milk
Among Markets and Class Uses
in Louisiana

D. C. WILLIAMS, JR.

WILLIAM H. ALEXANDER

SURPLUS
REQUIRMENTS AS
Superceded
Worn Out
Obsolete
Unbindable
Duplicated
NMSU LIBRARY
LAS CRUCES

Louisiana State University and
Agricultural and Mechanical College
Agricultural Experiment Station
Charles W. Upp, Director

TABLE OF CONTENTS

Introduction
- Objectives of the Study
- Method of Analysis
- Limitations of the Study
- Source of Data
- Definition of Terms and Market Description

Current and Optimum Flow of Producer Milk Between Louisiana Markets ... 1
- Marketing Areas ... 1
- Distance and Transfer Costs Between Markets ... 1
- Relationship of Milk Supplies to Class I Sales ... 1
- Transfer Costs and Returns from the Inter-Handler System ... 1

Current and Optimum Distribution of Producer Milk from Production Areas to Marketing Areas ... 2
- Period Used for Analysis ... 2
- Number and Location of Producers Associated with Milk Markets of Louisiana ... 2
- Basing Points for Production Areas ... 2
- Distance and Transfer Costs between Each Production Area and Each Marketing Area ... 2
- The Producer-Handler System ... 2
- Contrast of the Producer-Handler and the Current Systems of Milk Distribution ... 3

Comparative Analysis of Alternative Systems ... 3

Appendix ... 3
- Algebraic Presentation of the Formal Assumptions of the Transportation Model ... 3

ACKNOWLEDGMENT

The authors wish to acknowledge the Market Administrators of th New Orleans and the Northern Louisiana Federal Order Milk Markets and the Division of Milk Testing of the Louisiana Department of Agriculture and Immigration for providing valuable statistics and information.

Appreciation is extended to members of the department for suggestions in the preparation of the manuscript.

Thanks are also extended to individuals of the Louisiana State University computing center and Dr. Lonnie L. Fielder of the Departmen of Agricultural Economics for guidance in use of the electronic computing equipment used in the analysis.

Optimum Distribution of Producer Milk Among Markets and Class Uses In Louisiana

D. C. WILLIAMS, JR., AND WILLIAM H. ALEXANDER
Department of Agricultural Economics

INTRODUCTION

Fluid milk is a bulky and highly perishable commodity. The relatively low value-volume ratio for milk makes it expensive to ship long distances. This characteristic, together with sanitary requirements surrounding its production and distribution, has resulted in most of the milk being produced near centers of consumption. Generally speaking, the best interests of handlers, consumers and producers are served when handlers receive an adequate supply of milk from local producers.

Reports from state and federal fluid milk marketing agencies in Louisiana show that during the last few years the aggregate volume of milk received from producers who regularly supply handlers in the state has been greater than the quantity sold in Class I. This does not mean, however, that all handlers or all markets have received adequate supplies during all seasons of the year. For example, the reports show that, despite the aggregate surplus of producer milk, some handlers in all markets have utilized "other source" milk in meeting their requirements for Class I sales.

Objectives of the Study

The primary purpose of this study was to determine the optimum distribution of producer milk among markets and use classifications in Louisiana so as to yield maximum net returns to local producers from the sale of such milk.[1] The results of the study should be useful to all who are interested in production, distribution and consumption of milk, including farmers, handlers, marketing specialists, market administrators, consumers, and others.

The specific objectives of the study were:

(1) To determine whether or not the current volume of milk marketed by local producers could be distributed in such a manner that all handlers in the markets could be amply supplied with milk for their present Class I needs during all months of the year.

(2) To determine if, by a reorganization of present market channels, a greater volume of producer milk could be placed into Class I utilization and thus could return a higher net revenue to local producers.

---

[1] Local producers are considered to be those producers who regularly supply Louisiana markets with milk.

(3) To determine the optimum movements and allocation of pr ducer milk among marketing areas and/or production areas t provide maximum net returns for local producers.

Method of Analysis

The transportation model of the linear programming technique wa used in analyzing the flow, or movement, of milk. This method d termines the least cost of transferring a specified amount of a commodit from specific origins to specific destinations.

Formal Assumptions

The important formal assumptions for the transportation model ar as follows:[2]

(1) "Resources and products are homogenous." This statement mea that milk from markets with a reserve can be used in deficit markets.

(2) "The supplies of resources or products available at the variou origins and the demands of the various destinations are known; an total demand is equal to total supply." This assumption is necessary b cause the model does not allow for accumulation or depletion of inve tories. However, where the amount of excess is greater than deficit, c vice versa, this situation is handled by the use of dummy reserves c deficits.

(3) "The cost of (or profit from) converting resources to products c moving the commodity from origins to destinations is known and is i dependent of the number of units converted or moved." In this analys it is assumed that (a) the cost of transferring milk is a function of di tance, (b) the unit cost is the same for all areas and (c) the unit cost independent of volume of movement or the direction of the transfer.

(4) "There is an objective to be maximized or minimized." In th study the transfer costs were minimized.

(5) "Transportation from origins to destinations, or transformatio from resources to products, can be carried on only at non-negative levels.

These assumption are shown in algebraic form in the Appendix.

In problems of this nature more than one optimum allocation c distribution (more than one distribution with the same mimimun tran fer cost) is possible. The technique used will detect and indicate th various alternative optima if they exist.[3]

The volume of milk received from producers and the volume of mil sold in Class I were determined for all Louisiana markets. Where th volume sold as Class I was greater than the volume of milk received fro producers, the market was considered as "deficit" with respect to pr ducer milk. Where the volume of milk received from producers wa greater than the volume sold as Class I the market was considered to hav an excess of producer milk, an "excess" market.

---

[2] Earl O. Heady and Wilfred Candler, *Linear Programming Methods,* (Iowa: Th Iowa State College Press, 1958), pp. 339-340.

[3] Calculations were made on an IBM 650 computing machine. The computer pr gram was written by International Business Machine Corporation, New York. Th program is unique in that it will detect and indicate alternate optima when they exis

A central point in each market was selected, based primarily upon the dispersion of population and location of milk plants. The marketing areas were delineated into areas in which the same group of handlers were competing for the sale of bottled or bulk milk in all or part of the area. The excess supply of milk was allocated from the central points of the excess *markets* to the central points of the deficit *markets*. An alternative solution of the problem was made in which milk was allocated from the points of *production* to markets.

This study deals primarily with distribution or flow patterns of producer milk. The three distinct distribution systems or plans considered were as follows:

(1) The "current" system of distribution;

(2) The optimum distribution of producer milk from excess to deficit *markets* which is called in this context the "inter-handler system" of distribution; and

(3) The optimum distribution of producer milk from areas of *production* to handlers and it is called the "producer-handler system" of distribution.[4]

It would seem logical to present the current, the inter-handler and the producer-handler systems as separate sections. However, to compare each of the other systems with the one currently used, this procedure would require repetition because of the time periods for which data were available. Therefore, (in an attempt to avoid undue repetition) the inter-handler system is presented in connection with the current system, followed by a comparison of the producer-handler system with the current system and a comparative analysis of the three systems.

Limitations of the Study

Certain limitations are inherent in most studies. Some of the more important ones in this study are outlined.

The first limitation arises from the fact that utilization of milk in Class I (because of changes in inventories) may vary slightly over time. Total receipts and sales of milk within a given month include inventory variations and overages. Therefore, if disposition was not made in the same classification in which the variation occurred, utilization would be distorted by the extent of such variation.

The second limitation arises from the fact that milk sold within marketing areas, as shown in this study, may include a small amount of overlapping or cross sales between areas. Also, there was some double counting of producer milk due to inter-handler transfers. Such quantities, however, were generally small. The delineation of marketing and supply areas was somewhat arbitrary. Some desirable data were not available.

Finally, each market or source of supply was represented by a single point in an area. This is one of the mechanical requirements of the transportation model necessary for computational purposes. This fact may cause minor differences between actual transfer costs and the timated transfer cost.

---

[4] The "producer-handler system" as used herein should not be confused with a so-called producer-handler as sometimes identified in the dairy industry. In this context it refers to the pattern of movements of milk from dairy farmers to milk processors.

Source of Data

Data used in this study were obtained from audited marketing repor (monthly and annually) of the market administrators of the Feder Milk Marketing Orders in the state and from the Louisiana Depa ment of Agriculture and Immigration, Division of Milk Testing.

All of the milk marketed in the state was included in the study wi the exception of a relatively small amount handled by producer-handler Also a small quantity of milk was produced in the state and sold producers to handlers outside of the state. This volume was not includ in this study. A considerable quantity of milk was received regularly Louisiana handlers from producers in Mississippi, Texas and Arkansa Such receipts were included in this study. Some milk was sold to co sumers outside of the state by handlers located in the state, and this w included in the study. Some milk was sold to consumers in the state handlers located outside the state. These sales were not included. Ho ever, it is generally known that these volumes were relatively small an that the volume of milk brought into the state by handlers and the volum sold out of the state by Louisiana handlers were approximately equal.

Definition of Terms and Market Description[6]

Louisiana was divided into five milk marketing areas. They were t Northern, Central, Southwest, Southeast and New Orleans Marketi Areas. New Orleans was the largest and Central was the smallest mark in the state in terms of population, number of producers, number handlers and the volume of milk received and sold by handlers.

Milk received by handlers in Louisiana is identified according whether it is obtained from local producers or other sources. "Produc receipts" refer to that milk received by handlers from milk producer "Other source" receipts in this study refers to all other milk and mi products received by handlers from any source other than from pr ducers.

Under Louisiana regulations milk sales by handlers are classified int four use-class categories as follows:

> "**Class I** includes all milk utilized in regular bottled products, inclu ing bottled cream, concentrated milk, and all other milk not specifica ly accounted for in any of the other classifications. **Class I-A** includ all milk utilized in flavored drinks, plain buttermilk, and eggnog . . **Class I-B** includes all milk transferred between handlers for use i Class I on which a handling and transportation charge is applied . . **Class II** includes all milk utilized in ice cream; frozen dessert mi cottage and cream cheese; butter; evaporated, condensed and powde ed milk; and all other manufactured dairy products not required t

---

[5] Producer-handler means a dairy farmer who operates a milk distributing pla in which only his own production is processed.

[6] Producer-handler and inter-handler systems are defined on page 5.

be made from Grade A milk."[7]

For this analysis, Classes I, I-A and I-B were combined into Class I. This was done so that Classes I and II under the state order would be comparable to similar classifications used in the Federal Milk Marketing Orders. Class I then is that milk used for consumption in the fluid form, either in bottles or bulk, and Class II milk is used in manufactured milk products such as ice cream, cottage cheese, butter, and all other manufactured dairy products.

Table 1.—Average Number of Producers and Average Daily Delivery of Milk to Handlers by Marketing Areas, and State Total, Louisiana, 1955-59

Year	Northern[1]		Central	
	Number of Producers	Average Daily Delivery Per Producer	Number of Producers	Average Daily Delivery Per Producer
	No.	*Pounds*	*No.*	*Pounds*
1955	649	505	92	449
1956	646	567	84	511
1957	657	598	81	564
1958	615	633	73	583
1959	573	711	84	614

Year	Southwest		Southeast	
	Number of Producers	Average Daily Delivery Per Producer	Number of Producers	Average Daily Delivery Per Producer
	No.	*Pounds*	*No.*	*Pounds*
1955	680	375	815	360
1956	638	407	797	424
1957	686	454	878	434
1958	696	487	544	602
1959	662	551	455	633

Year	New Orleans			Louisiana	
	Number of Producers		Average Daily Delivery Per Producer	Number of Producers	Average Daily Delivery Per Producer
	La.	Miss.			
	No.		*Pounds*	*No.*	*Pounds*
1955	1,891	709	316	4,835	376
1956	1,754	720	361	4,639	406
1957	1,543	715	395	4,559	444
1958	1,544	834	391	4,306	469
1959	1,478	697	446	3,948	527

[1] Prior to August 1958, data for the Shreveport and Northeast Louisiana Marketing Areas were summed for the two areas. Since that time the combined areas constituted the Northern Louisiana Marketing Area under Federal Order No. 66.

Source: *Louisiana Annual Milk Marketing Report, 1959,* (Division of Milk Testing, Louisiana Department of Agriculture and Immigration).

---

[7] David R. Daniel, *Louisiana Annual Milk Marketing Report* (Baton Rouge, Louisiana: Louisiana Department of Agriculture and Immigration, Division of Milk Testing), p. iii.

In Louisiana, milk is purchased from producers on the basis of it weight and butterfat content and priced in accordance with its class use Since Class I milk has a relatively fixed demand it commands the highes price. Class II milk may be diverted into nonfluid uses, thus receives lower price. A major purpose of the classification system is to permi surplus milk (classified as Class II) to be sold within a given marke without causing a serious break in the Class I price structure.

The number of producers shipping milk to handlers in the fiv markets has declined from 4,835 in 1955 to 3,948 in 1959 (Table I). O the other hand, the average daily delivery per producer increased fron 376 pounds in 1955 to 527 pounds in 1959. Proportionately the numbe of producers was 18 per cent less in 1959 than in 1955, while the av erage daily delivery per producer was 40 per cent greater. Also the tota volume of milk received from producers in 1959 was greater than in 1955

Figure 1.—Volume of Milk Received from Producers and Total Class I Sales by Hand lers, Louisiana, 1955-59.

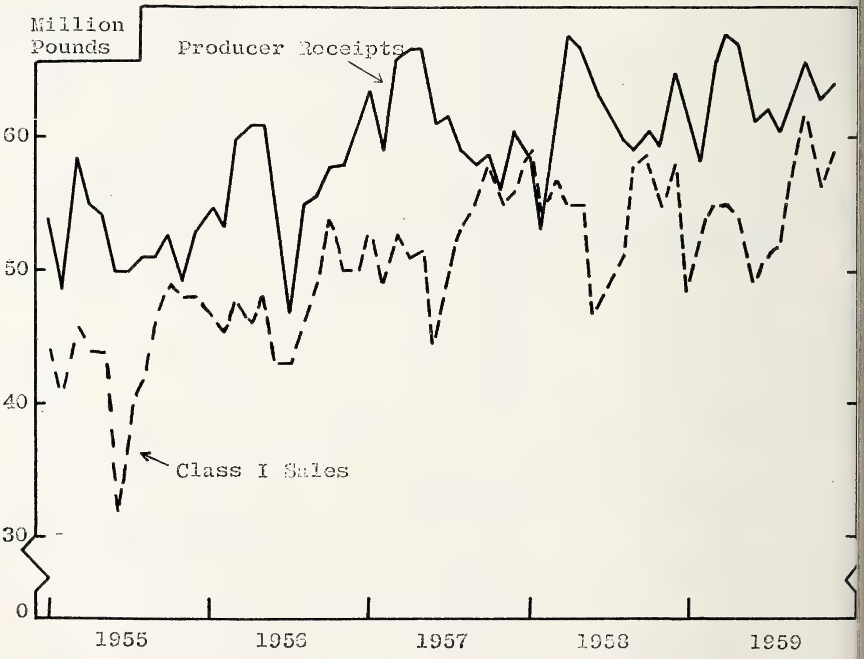
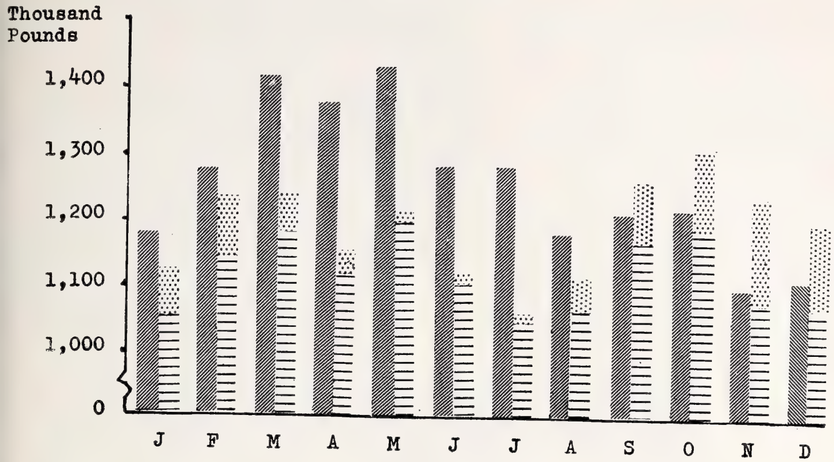


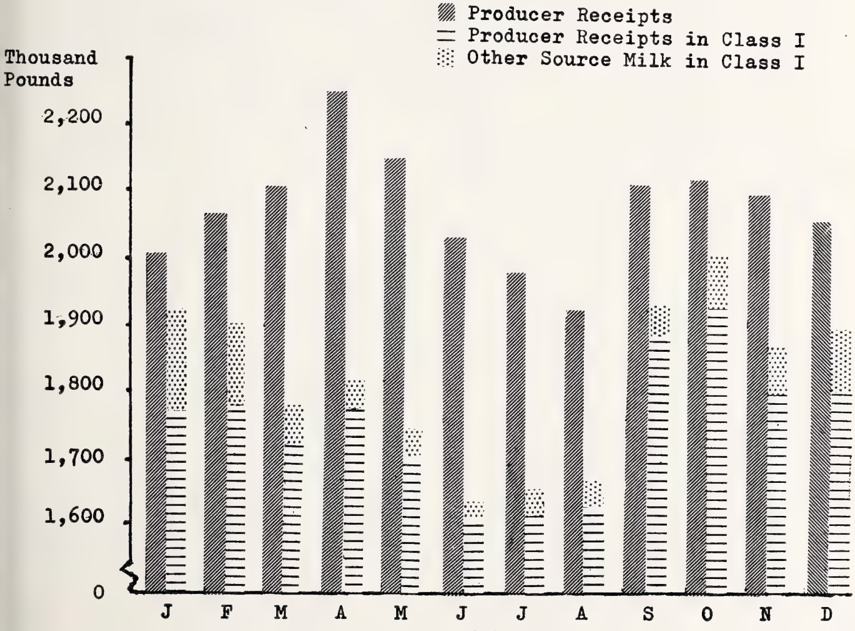
Figure 1 shows that producer receipts and Class I sales in Louisian have been increasing. Producer receipts and Class I sales were 21 and 2 per cent greater, respectively, in 1959 than in 1955. In the most recen five-year period, seasonality of producer receipts and Class I sales ha usually exhibited bimodal peaks in the spring and in the fall.

For the state as a whole, producer receipts were greater than Class sales every month from 1955 through 1959 except in February 1958. Ye handlers in some markets received less milk from producers than they sol in Class I. Figure 2 shows that there was less variation for producer re

Figure 2.—Milk Received from Producers and Class I Sales by Handlers in Louisiana, Daily Average by Months, 1951 and 1959.



(A) 1951



(B) 1959

ceipts than for Class I sales during 1959. Likewise producer receipts exceeded Class I sales during all months. Despite the apparent adequacy of producer receipts milk to supply all Class I needs, some Class I sales were derived from other source milk. Figure 2 also shows there has been a tendency to level out seasonality of producer deliveries since 1951.

Factors that undoubtedly influenced the change include: (1) the "base-excess" plan which was put into effect in the state around 1950, and (2) the "supply-demand" adjustment provision that has been in force part of the time in the New Orleans Marketing Area.[9]

The Northern Louisiana Marketing Area and the New Orleans Marketing Area operate under Federal Milk Marketing Orders.[10] The remaining markets are regulated by the Louisiana Milk Audit Law. Thi act does not provide for the establishment of minimum prices to producers.[11] Both the Federal Orders and the Louisiana Milk Audit Law have provisions designed to allocate producer milk to the highest use class within a plant, but they do not provide for allocation of producer milk among markets. One hypothesis of this study is that producer milk has not been allocated among handlers in Louisiana in a manner tha would maximize net returns to local producers.

CURRENT AND OPTIMUM FLOW OF PRODUCER MILK BETWEEN LOUISIANA MARKETS

Marketing Areas

The state of Louisiana was divided into five different milk marketing areas.[12] These areas together with their designated central points are illustrated in Figure 3. A central point was selected within each marke on the basis of the dispersion of population and location of milk pasteurizing plants. During the five-year period 1955-59 some of these marketing areas were not adequately supplied with milk from local producers during all months of the year. When area deficits existed, supplies were generally drawn from sources outside the state or from other handler

---

[8] The "base-excess" plan is a method for deliberately modifying the seasonal flow of milk, usually to flatten out the seasonal supply curve, or maintain a relatively constant relationship of producer receipts to Class I sales. It uses to a large extent discriminate pricing features to accomplish its objectives. For a more detailed explanation of the "base-excess" plan see: William H. Alexander and Albert Ortego, Jr., *Operation of Base-Excess Plans Under State and Federal Regulations in Louisiana,* (Louisiana Agricultural Experiment Station D.A.E. Circular No. 212, August, 1957).

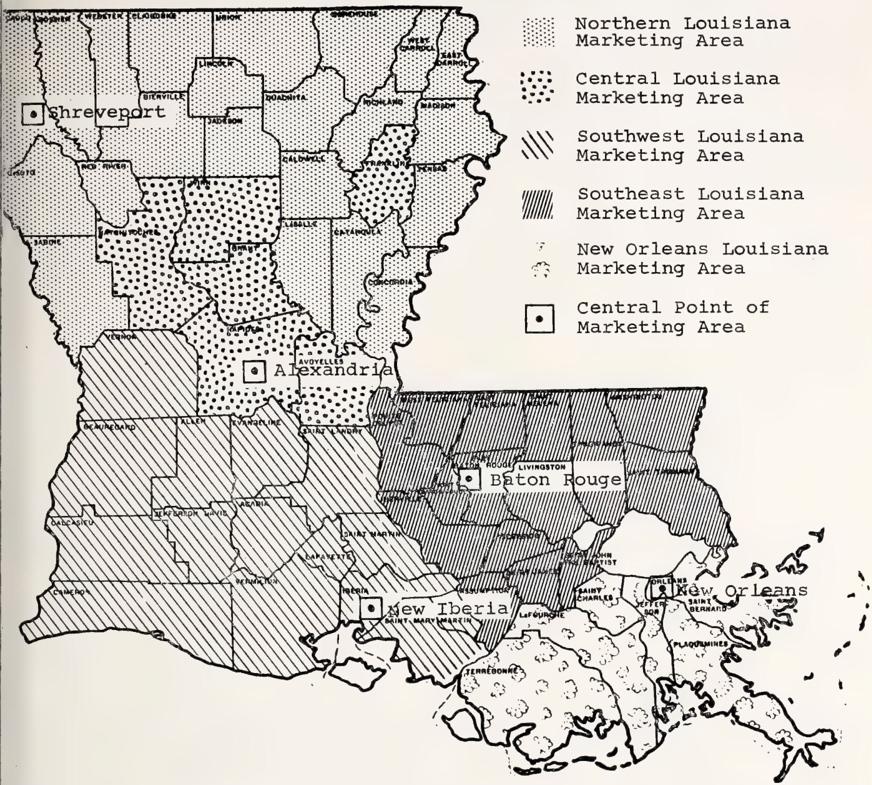
[9] United States Department of Agriculture, *Order Amending the Order, Regulating the Handling of Milk in the New Orleans, Louisiana, Marketing Area,* (Washington D.C.: Agricultural Marketing Service, January 27, 1960), p. 5.

[10] A Federal Milk Marketing Order is a regulation issued by the Secretary of Agriculture at the request of dairy farmers. It regulates the handling of milk by placing certain requirements on milk dealers who sell milk in the area. It requires that dairy farmers regularly supplying the market be paid not less than certain minimum prices established in accordance with the form in which it is sold. It requires payment to producers on the basis of a uniform price.

[11] A State Milk Marketing Order was issued in December 1960, which established identical minimum prices to be paid to producers by all handlers in the state fo milk sold in Class I. This order also established a minimum Class II price to all handlers. It also has provisions designed to allocate producer milk to the highest use class within a plant. It does not provide for allocation of producer milk among markets

[12] The Northern and New Orleans Markets are regulated by Federal Milk Marketing Orders and the Central, Southwest and Southeast Markets are regulated by the Louisiana Milk Audit Law. The data were reported by marketing areas.

Figure 3.—Milk Marketing Areas of Louisiana and Designated Central Points.


Northern Louisiana Marketing Area
Central Louisiana Marketing Area
Southwest Louisiana Marketing Area
Southeast Louisiana Marketing Area
New Orleans Louisiana Marketing Area
Central Point of Marketing Area
Shreveport
Alexandria
Baton Rouge
New Iberia
New Orleans

within the state. This suggested that sufficient producer milk might be available to supply the needs of all markets for Class I use. If this hypothesis were true, then all markets might be adequately supplied with milk from local producers by a change in the system of distribution.

As a first step in the analysis, the amount of excess and deficit milk was determined for each market area, by months, during 1959. The optimum flow of milk from excess markets to fill the needs of deficit markets was determined by *the inter-handler system.*[13] The formal assumptions of the transportation model were set forth on page 4. It was further assumed that no barriers existed to prevent the movement of milk between markets. Each market area was assumed to be represented by a fixed point, called the central point. The transfer rates were assumed to be: (1) proportional to distance, (2) identical per unit in all areas, and (3) independent of volume hauled or the direction of transfer. The distribution of producer milk from farm to market was taken to be the same as was reported in 1959.

Distance and Transfer Costs Between Markets

Actual transfer costs are difficult to obtain. There are various methods of estimating distance and costs. For the purpose of the present study transfer costs were estimated, based on 2.18 cents per 1,000 pounds pe highway mile. The rate was obtained from a study by the United State Department of Agriculture.[14]

---

[13] The inter-handler system is defined on page 5.

The distance between the central points of each market is shown i Table II and the estimated transfer costs in Table III. The transfer cost shown are assumed to approximate total transfer cost. However, th actual transfer cost may vary because of inter-firm or intra-company transfers. A change in the transfer cost would not affect the optimum distribution pattern provided that the change was proportional between eac origin and each destination and that the transfer cost was not greate than the difference between the Class II and Class I prices. In this stud the estimated transfer costs were always less than the difference betwee Class I and Class II prices within and between each alternative market

Table II.—Mileage Between Central Points in Milk Marketing Areas in Louisiana[1]

	Market Areas				
Market Areas	Northern	Central	Southwest	Southeast	New Orleans
Northern	0	127	239	238	319
Central	127	0	112	111	192
Southwest	239	112	0	106	149
Southeast	238	111	106	0	81
New Orleans	319	192	149	81	0

[1] The distances were computed from the mileage shown on *Texaco Touring Map of Louisiana* (Chicago: The N. M. Gousha Co., 1959).

Table III.—Estimated Transfer Cost Between Central Points of Milk Marketing Area in Louisiana

	Market Areas				
Market Areas	Northern	Central	Southwest	Southeast	New Orleans
	— — — — Dollars per Thousand Pounds — — — —				
Northern	0	2.77	5.21	5.19	6.95
Central	2.77	0	2.44	2.42	4.19
Southwest	5.21	2.44	0	2.31	3.25
Southeast	5.19	2.42	2.31	0	1.77
New Orleans	6.95	4.19	3.25	1.77	0

Relationship of Milk Supplies to Class I Sales

For seven months in 1959 the Northern Market received more mil from producers than was needed for Class I requirements but was defici for the five remaining months. The Central Market was under-supplie with producer milk every month of 1959. Producer deliveries exceede Class I sales during four months and were less than Class I sales for eigh months in the Southwest Market. The Southeast Market was inadequately supplied with producer milk during only two months. Produce deliveries exceeded Class I sales during all months in the New Orlean Market Area (Table IV).

---

[14] Louis F. Herrmann, "Geographic Structure of Milk Prices," *The Market an Transportation Situation,* (United States Department of Agriculture, Agricultura Marketing Service, July, 1959), pp. 29-31.

Table IV.—Producer Receipts and Class I Sales by Markets and the Movement of Milk That Would Have Been Necessary to Obtain Optimum Distribution of Producer Milk by the Inter-Handler System, Louisiana, 1959

	Northern Louisiana Market									
					Shipped to or Received From					
Month	Producer Receipts	Class I Sales	Excess	Deficit	Central	South-west	South-east	New Orleans	Remaining Excess	Remaining Deficit
			– – – – – – – – – –	– – – – – –	Thousand Pounds	– – – – – –	– – – – – –	– – – – – –		
Jan.	11,753	13,091	-0-	1,338	-0-	-0-	-0-	1,338	-0-	-0-
Feb.	10,868	11,726	-0-	858	-0-	-0-	-0-	858	-0-	-0-
Mar.	12,534	12,458	76	-0-	-0-	-0-	-0-	-0-	76	-0-
Apr.	13,153	12,254	899	-0-	-0-	-0-	-0-	-0-	899	-0-
May	13,033	11,860	1,173	-0-	-0-	-0-	-0-	-0-	1,173	-0-
June	11,807	10,487	1,320	-0-	-0-	-0-	-0-	-0-	1,320	-0-
July	11,859	10,950	909	-0-	52	-0-	-0-	-0-	857	-0-
Aug.	12,041	11,127	914	-0-	-0-	-0-	-0-	-0-	914	-0-
Sept.	13,526	12,912	614	-0-	-0-	-0-	-0-	-0-	614	-0-
Oct.	13,439	13,901	-0-	462	-0-	-0-	408	54	-0-	-0-
Nov.	12,411	12,497	-0-	86	-0-	-0-	86	-0-	-0-	-0-
Dec.	12,347	13,197	-0-	850	-0-	-0-	189	661	-0-	-0-

(Continued)

Table IV. (Continued)—Producer Receipts and Class I Sales by Markets and the Movement of Milk That Would Have Been Necessary to Obtain Optimum Distribution of Producer Milk by the Inter-Handler System, Louisiana, 1959

	Central Louisiana Market									
					Shipped to or Received From					
Month	Producer Receipts	Class I Sales	Excess	Deficit	Northern	South-west	South-east	New Orleans	Remaining Excess	Remaining Deficit
			— — — — — — — — — — — — Thousand Pounds — — — — — — — — — — — —							
Jan.	1,324	2,628	-0-	1,304	-0-	-0-	-0-	1,304	-0-	-0-
Feb.	1,277	2,268	-0-	991	-0-	-0-	-0-	991	-0-	-0-
Mar.	1,669	2,355	-0-	686	-0-	338	348	-0-	-0-	-0-
Apr.	1,775	2,222	-0-	447	-0-	-0-	447	-0-	-0-	-0-
May	1,741	2,026	-0-	285	-0-	-0-	285	-0-	-0-	-0-
June	1,559	1,773	-0-	214	-0-	-0-	214	-0-	-0-	-0-
July	1,591	1,693	-0-	102	52	-0-	50	-0-	-0-	-0-
Aug.	1,630	1,999	-0-	369	-0-	-0-	369	-0-	-0-	-0-
Sept.	1,716	2,102	-0-	386	-0-	-0-	386	-0-	-0-	-0-
Oct.	1,693	2,276	-0-	583	-0-	-0-	583	-0-	-0-	-0-
Nov.	1,461	2,027	-0-	566	-0-	-0-	566	-0-	-0-	-0-
Dec.	1,433	2,039	-0-	606	-0-	-0-	606	-0-	-0-	-0-

(Continued)

Table IV. (Continued)—Producer Receipts and Class I Sales by Markets and the Movement of Milk That Would Have Been Necessary to Obtain Optimum Distribution of Producer Milk by the Inter-Handler System, Louisiana, 1959

	Southwest Louisiana Market									
					Shipped To or Received From					
Month	Producer Receipts	Class I Sales	Excess	Deficit	Northern	Central	South-east	New Orleans	Remaining Excess	Remaining Deficit
			Thousand Pounds							
Jan.	10,650	11,740	-0-	1,090	-0-	-0-	-0-	1,090	-0-	-0-
Feb.	9,762	10,444	-0-	682	-0-	-0-	-0-	682	-0-	-0-
Mar.	11,606	11,145	461	-0-	-0-	338	-0-	-0-	123	-0-
Apr.	11,726	10,872	854	-0-	-0-	-0-	-0-	-0-	854	-0-
May	11,273	10,939	334	-0-	-0-	-0-	-0-	-0-	334	-0-
June	10,061	9,914	147	-0-	-0-	-0-	-0-	-0-	147	-0-
July	10,418	10,513	-0-	95	-0-	-0-	95	-0-	-0-	-0-
Aug.	10,688	10,723	-0-	35	-0-	-0-	35	-0-	-0-	-0-
Sept.	11,687	11,808	-0-	121	-0-	-0-	121	-0-	-0-	-0-
Oct.	12,146	12,317	-0-	171	-0-	-0-	-0-	171	-0-	-0-
Nov.	11,420	11,483	-0-	63	-0-	-0-	63	-0-	-0-	-0-
Dec.	11,558	11,811	-0-	253	-0-	-0-	-0-	253	-0-	-0-

(*Continued*)

Table IV. (Continued)—Producer Receipts and Class I Sales by Markets and the Movement of Milk That Would Have Been Necessary to Obtain Optimum Distribution of Producer Milk by the Inter-Handler System, Louisiana, 1959

	Southeast Louisiana Market									
					Shipped To or Received From					
Month	Producer Receipts	Class I Sales	Excess	Deficit	Northern	Central	South-west	New Orleans	Remaining Excess	Remaining Deficit
			– – – – – – – – – – – – Thousand Pounds	– – – – – – – – – – – –						
Jan.	8,923	9,219	-0-	296	-0-	-0-	-0-	296	-0-	-0-
Feb.	7,950	8,271	-0-	321	-0-	-0-	-0-	321	-0-	-0-
Mar.	8,415	8,067	348	-0-	-0-	348	-0-	-0-	-0-	-0-
Apr.	8,587	8,022	565	-0-	-0-	447	-0-	-0-	118	-0-
May	8,463	7,929	534	-0-	-0-	285	-0-	-0-	249	-0-
June	7,552	7,026	526	-0-	-0-	214	-0-	-0-	312	-0-
July	7,603	7,458	145	-0-	-0-	50	95	-0-	-0-	-0-
Aug.	7,957	7,551	406	-0-	-0-	369	35	-0-	2	-0-
Sept.	9,065	8,506	559	-0-	-0-	386	121	-0-	52	-0-
Oct.	10,931	9,940	991	-0-	408	583	-0-	-0-	-0-	-0-
Nov.	10,341	8,748	1,593	-0-	86	566	63	-0-	878	-0-
Dec.	8,934	8,139	795	-0-	189	606	-0-	-0-	-0-	-0-

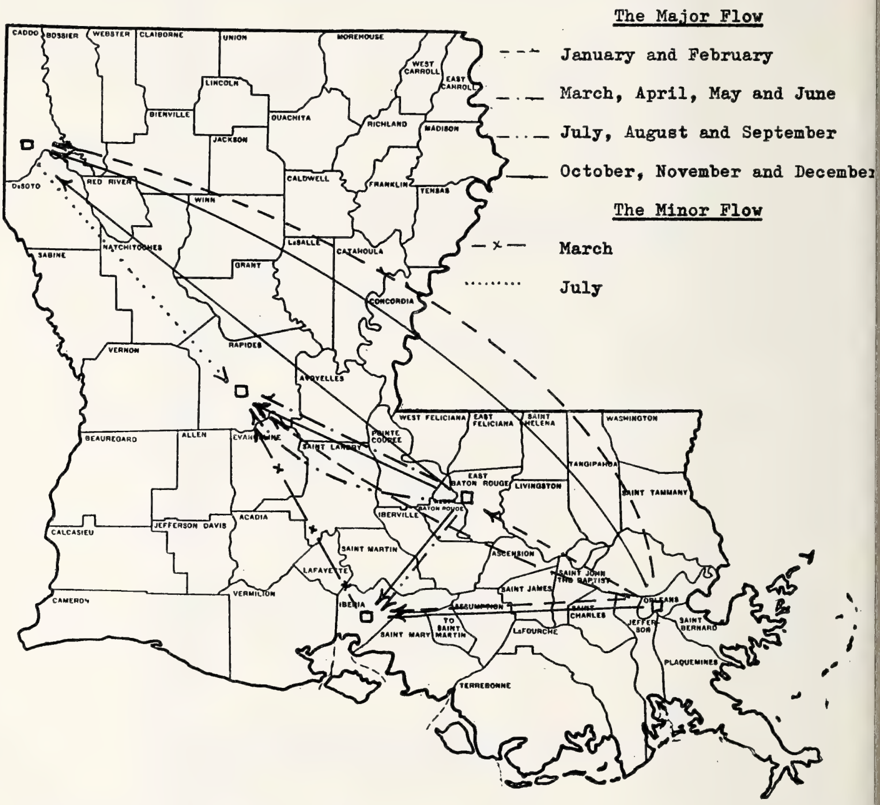
(Continued)

Table IV. (Continued)—Producer Receipts and Class I Sales by Markets and the Movement of Milk That Would Have Been Necessary to Obtain Optimum Distribution of Producer Milk by the Inter-Handler System, Louisiana, 1959

	New Orleans Market									
					Shipped To or Received From					
Month	Producer Receipts	Class I Sales	Excess	Deficit	Northern	Central	South-west	South east	Remaining Excess	Remaining Deficit
			– – – – – – – – – – – – – Thousand Pounds – – – – – – – – – – – – –							
Jan.	29,689	23,097	6,592	-0-	1,338	1,304	1,090	296	2,564	-0-
Feb.	28,131	20,662	7,469	-0-	858	991	682	321	4,617	-0-
Mar.	31,139	21,311	9,828	-0-	-0-	-0-	-0-	-0-	9,828	-0-
Apr.	32,409	21,260	11,149	-0-	-0-	-0-	-0-	-0-	11,149	-0-
May	32,298	21,380	10,918	-0-	-0-	-0-	-0-	-0-	10,918	-0-
June	30,244	19,927	10,317	-0-	-0-	-0-	-0-	-0-	10,317	-0-
July	30,349	20,585	9,764	-0-	-0-	-0-	-0-	-0-	9,764	-0-
Aug.	27,586	20,748	6,838	-0-	-0-	-0-	-0-	-0-	6,838	-0-
Sept.	27,381	22,579	4,802	-0-	-0-	-0-	-0-	-0-	4,802	-0-
Oct.	27,689	23,944	3,745	-0-	54	-0-	171	-0-	3,520	-0-
Nov.	27,293	21,334	5,959	-0-	-0-	-0-	-0-	-0-	5,959	-0-
Dec.	29,535	23,675	5,860	-0-	661	-0-	253	-0-	4,946	-0-

Table IV shows the amount of excess or deficit milk supplies in each market and the movements of milk from or into the market under optimum distribution by the *inter-handler system*. For example, the Northern Market was deficit by 1.3 million pounds in January. By reading across the row for January, one sees that the Northern Market under optimum conditions would have received 1.3 million pounds, the amount of its deficit, from the New Orleans Market. When a market had an excess, under optimum distribution, part or all of the excess would have been shipped to deficit markets. This situation was also the case in July for the Northern Market. The Northern Market had an excess of 909,000 pounds in July and under optimum distribution 52,000 pounds of milk would have been shipped to the Central Market. Since transfer cost would not have been minimized by shipping milk from the Northern Market to another market for Class I use, 857,000 pounds would have remained in the market for Class II use.

Figure 4.—Seasonal Flow Pattern of Producer Milk Among Markets to Place Maximum Volume of Such Milk in Highest Use Class.



There were essentially four major flow patterns for the year (Figure 4). Minor flows (shown in Figure 4) were from excess markets supplying part or all of the requirements for deficit markets for only one month during the year.

Since in the aggregate there was a net excess of producer milk over Class I sales during 1959, the optimum solution did not permit some excess markets to dispose of their entire excess to a deficit market. In such cases the excess milk remained in the market or production areas in which it originated. New Orleans was the only market under the optimum solution that retained excess milk every month during the period under analysis.

Since the historical data showed that the volume of Class II sales in each market was greater than the volume of excess producer milk, it was assumed that the excess milk remaining in a specific market could be utilized for Class II products.

Transfer Costs and Returns from the Inter-Handler System

The total volume of excess milk in the state was 107 million pounds in 1959. For the same period the aggregate volume of deficit within all markets was 13 million pounds. Assuming no change in milk use characteristics, through the optimum distribution pattern shown above 13 million pounds of producer milk could have been transferred from Class II use to Class I use. Under these conditions the excess would have been reduced to 94 instead of the 107 million pounds shown in the market statistics.

Estimated minimum transfer costs and total returns from such transfers together with net returns resulting from the inter-handler system are shown in Table V. The additional returns resulting from a shift of milk from Class II to Class I use was determined for each month. This was done by subtracting the Class II price in the excess market from the Class I price in the deficit market (where the excess was transferred) and

Table V.—Estimated Costs and Returns from the Optimum Distribution of Producer Milk by the Inter-Handler System, Louisiana, 1959

Month	Total Returns from Transfer	Total Minimum Transfer Costs	Net Returns
		— — — — — Dollars — — — — —	
January	103,022	18,829	84,193
February	75,456	12,899	62,557
March	21,184	1,667	19,517
April	13,634	1,082	12,552
May	9,206	690	8,516
June	6,227	518	5,709
July	5,978	484	5,494
August	11,203	973	10,230
September	16,847	1,214	15,633
October	38,490	4,459	34,031
November	24,249	1,962	22,287
December	49,528	7,864	41,664
Total	375,024	52,641	322,383

multiplying that differential by the volume of milk transferred. The estimated additional returns resulting from an optimum allocation of producer deliveries would have been $375,000 less the total minimum transfer cost of $53,000 or a net increase of $322,000 to local producers during 1959. Table V also shows that the greatest benefit from such redistribution would have occurred during the months of December, January and February. On the other hand, added net returns would have been lowest during May, June and July (Table V).

The net returns from optimum distribution of producer milk might deviate slightly from this estimate for the following reasons: (1) transfer costs might have deviated from the estimates used; (2) all handlers were not located at a single central point as assumed; (3) at times, some handlers in a given market received excess producer milk while other handlers were deficit.

CURRENT AND OPTIMUM DISTRIBUTION OF PRODUCER MILK FROM PRODUCTION AREAS TO MARKETING AREAS

As was noted earlier, producer milk was not distributed among markets in such a way as to utilize the maximum amount of such milk in Class I during 1959. The optimum distribution was accomplished by synthetically allocating producer milk from excess to deficit markets.

The objective at this point is to determine whether or not a change in the flow pattern from producers to handlers would result in a smaller transfer cost in allocating producer milk among markets and class uses than was obtained under the inter-handler system of distribution. Optimum distribution of producer milk from areas of production to markets where needed could be achieved more easily at present than five years ago. This is a result of the increase in use of bulk milk tanks on farms. With few exceptions, the remaining can receiving facilities are at a few country receiving stations, which are operated by producer cooperatives. The milk is received in cans at these stations and then loaded into bulk tanks for transfer to handlers' plants.

Period Used for Analysis

Ideally, the data needed to show the optimum flow of milk from farms to market would be the daily production and sales of milk by each producer for each day of the year. Unfortunately, audited production data were available for individual farms by parishes only for the base-forming period; therefore, the base-forming period was chosen as the time period for determining the optimum distribution of producer milk from production areas to marketing areas. The base-forming period of the fall of 1958 was chosen because the bases established at that time would apply during the base-operating period in 1959. Also, this was the most recent base-forming period for which data were available.

As shown in Table V, the fall months were generally when supplies were shortest in the deficit markets. The base-forming period is generally a period of low seasonal production. It is set to encourage producers o modify the normal seasonal pattern of production by increasing production during the base period and lowering production during periods when surpluses are most acute.

The base-forming period for the Northern Market was from Sepember through December and the base-operating period was February hrough July. The Central, Southwest, and the Southeast Markets had he same base-forming period as the Northern Market, but their base-operating periods were from January through August rather than Febuary through July. In the New Orleans Market the base-forming period was from October through February, and the base-operating period was March through August. Inasmuch as average daily producer deliveries were approximately the same in the New Orleans Market during the enire period from September, 1958, through February, 1959, it is logical o assume that the volume of established bases would be the same for hat market if calculated for the September-December period or the dentical time period for the other markets.

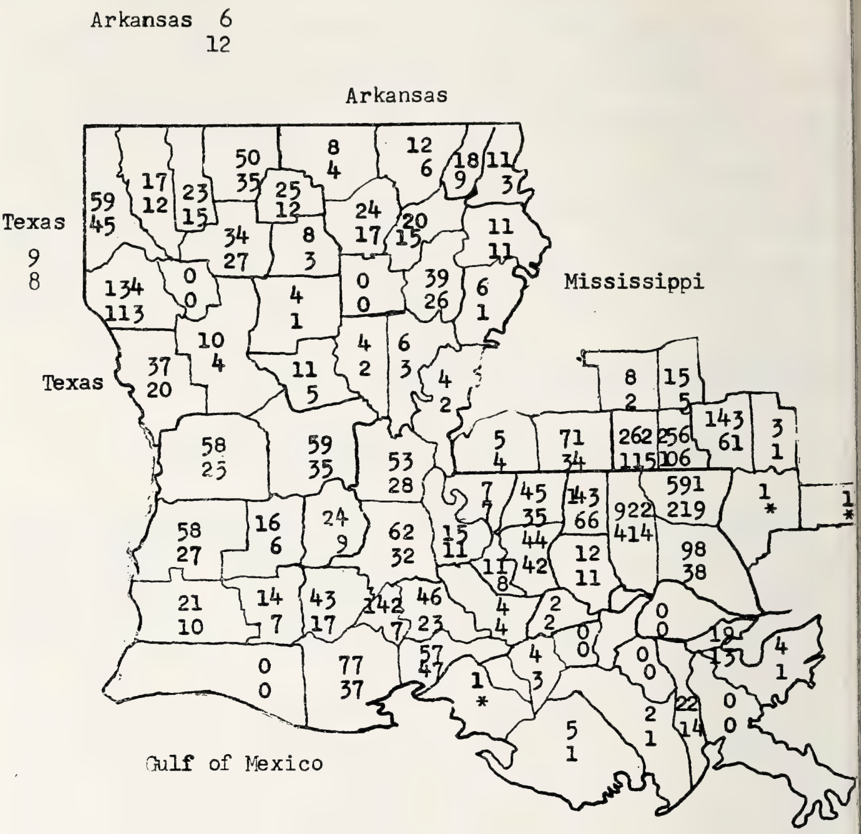
Number and Locations of Producers Associated With Milk Markets of Louisiana

Location of producers and volume of production were determined in order to delineate production areas. The total number of producers, by parishes or counties, associated with milk markets in Louisiana during he 1958 base-forming period is shown in Figure 5. It also shows the total daily base pounds of milk per parish or county, and the source of milk upply for Louisiana.

Louisiana milk handlers secured the major proportion of their Class milk requirements from 4,032 base-holding producers during 1959. Producers with bases established during the 1958 base-forming period were distributed geographically as follows: Louisiana, 3,252; Mississippi, 765; Arkansas, 6; and Texas 9. Louisiana producers held bases equaling 82.6 per cent of the aggregate daily delivery base of 2.0 million pounds. The average daily Class I sales in Louisiana (for the same period) were 1.9 million pounds (Table VI). Thus, the total average daily base was 106 per cent of the average daily Class I sales. The average daily base established by Louisiana producers was 87.8 per cent of the average daily Class I sales in all markets of the state. Louisiana production was not sufficient to supply Class I sales requirements during the base-forming period of 1958. However, the total volume of milk produced by producers holding bases in the five Louisiana market areas would have been adequate during that period had it been properly distributed.

Producers in Mississippi who shipped to Louisiana markets had a lower percentage of their milk utilized in Class I than did the average Louisiana producer. The reason was that Mississippi producers shipped primarily to the New Orleans and Southeast Markets. These two markets were excessively supplied during 1959—particularly the New Orleans Market, where most of the Mississippi producers shipped. However, the

Figure 5.—Number of Producers and Total Daily Base Pounds Established in Louisia Milk Markets, by Parish, 1959.



Explanation

Upper Figure - Represents number of producers.

Lower Figure - Represents daily base established in thousand pounds.

*Less than one thousand pounds.

Louisiana producers shipping to the New Orleans Market received th same class utilizations as Mississippi producers because the market w operating under a market-wide pool. Other Louisiana producers shipping to deficit markets, however, received a higher Class I utilizatio thereby resulting in a higher Class I utilization for the average produce in Louisiana.

Figure 5 shows that the greatest concentration of production by bas

Table VI.—Average Daily Base Established by Production Areas and Class I Sales by Marketing Areas of Louisiana During the Base-Forming Period of 1958[1]

roduction Area	Average Daily Milk Production	Marketing Area	Average Daily Class I Sales	Excess	Deficit
	Thousand Pounds		— — — Thousand Pounds	— — —	
	293	Northern	412	-0-	119
I	110	....	...	110	...
II	98	Central	78	20	-0-
V	49	....	.	49	...
V	242	Southwest	375	-0-	133
VI	128	Southeast	301	-0-	173
VII	31	New Orleans	728	-0-	697
VIII	480	....	..	480	...
X	257	....	...	257	...
X	152	....	...	152	...
XI	173	....	. .	173	...
Total	2,013	....	1,894	1,241	1,122

[1] The base-forming period was September through December 1958 for each of the marketing areas xcept the New Orleans marketing area, which was October 1958 through February 1959. It was ssumed that the base-forming period for the New Orleans market was representative of the base-orming period for the other markets.

holding milk producers supplying Louisiana markets was in Southeast Louisiana and Southwest Mississippi. The average daily base established by producers residing in Tangipahoa and Washington Parishes in Louisiana and the contiguous counties of Pike and Walthall in Mississippi accounted for 42.5 per cent of the total average daily base established with all markets of Louisiana during the base-forming periods. The New Orleans Market handled almost half the state's total milk supply. The sales volume of Class I milk was greatest in the New Orleans Market. Yet the concentration of production was lowest in that marketing area.

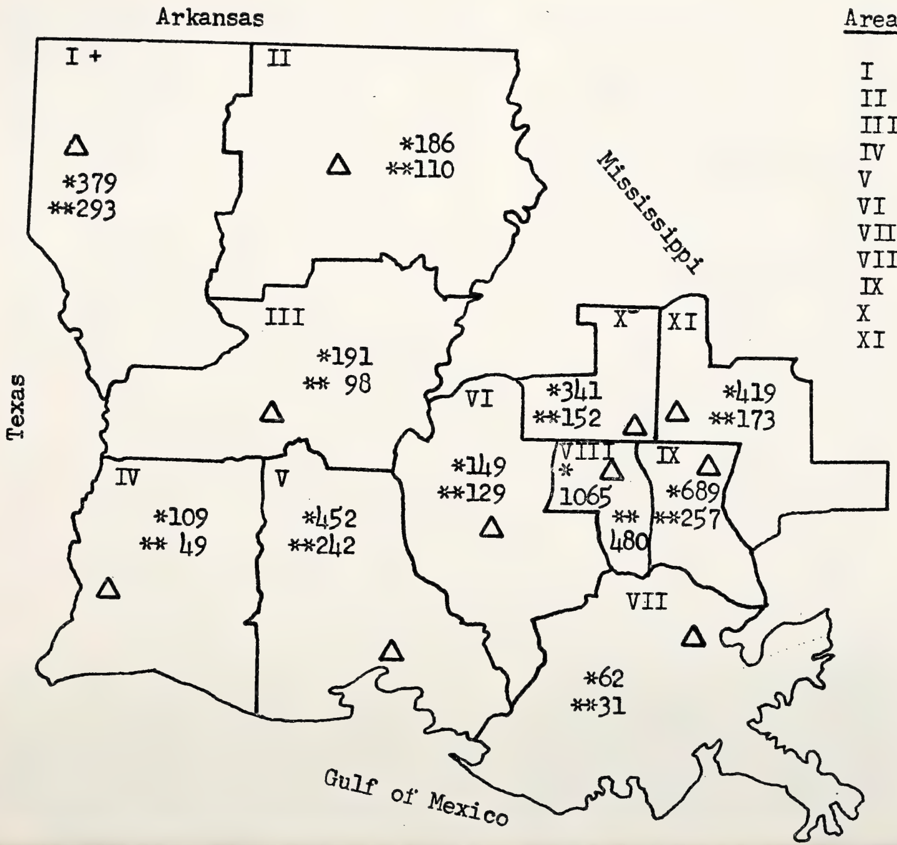
Basing Points for Production Areas[15]

Production areas were delineated for the purpose of ascertaining the amount of milk produced within the areas. Because it was necessary to assume only one basing point for assembling milk by handlers in each marketing area, dividing the territory into 11 production areas would provide a meaningful basis for determining the optimum flow patterns. The markets in which given producers held bases served to delineate the production areas and the central points from which distribution was made. The production areas, the selected base point for each area, the daily base, and the number of producers are illustrated in Figure 6. The production areas will be referred to by numbers.

The location of the production areas and the base delivery point for each area were based on density of milk production and the current location of milk receiving and cooling stations and milk processing plants. The location of milk producers and the concentration of pro-

---

[15] For the purpose of ascertaining optimum distribution of producer milk from production areas to market, each production area was assumed to be represented by a fixed point called the base point.



Areas	Basing Points
I	Shreveport
II	Monroe
III	Alexandria
IV	Lake Charles
V	New Iberia
VI	Baton Rouge
VII	New Orleans
VIII	Kentwood
IX	Franklinton
X	Magnolia
XI	Tylertown

△ Base point
* Number of producers.
** Established daily base in thousand pounds.
+ Area I includes a small volume of milk production in Texas and Arkansas.

luction associated with the milk markets of Louisiana during the base-orming period of 1958 are shown in Figure 5.

Distance and Transfer Costs Between Each Production Area and Each Marketing Area

The distance between the central point of each production area and ach marketing area is shown in Table VII and the estimated transfer ost in Table VIII. As noted earlier, the transfer cost was computed as 2.18 cents per 1,000 pounds per mile distance. In Table VIII there is no transfer charge shown from some production areas to specified markets, due to the assumption that the total volume of milk produced in each production area was concentrated at one fixed point and that the total demand for milk by handlers in each marketing area was concentrated

Table VII.—Estimated Mileage Between Central Points of Milk Marketing Areas of Louisiana and the Production Areas[1]

	Marketing Areas				
Production Areas	Northern	Central	Southwest	Southeast	New Orleans
	0	127	239	238	319
I	105	92	204	184	265
II	127	0	112	111	192
V	186	94	94	138	243
V	239	112	0	106	149
VI	238	111	106	0	81
VII	319	192	149	81	0
VIII	276	180	179	73	86
X	296	191	187	81	94
X	262	166	193	87	100
XI	275	179	214	108	121

---

[1] Mileage was obtained from *Texaco Touring Map of Louisiana*, (Chicago: The N. M. Gousha Co., 1959).

Table VIII.—Estimated Transfer Cost Between the Central Points of Milk Market Areas of Louisiana and the Milk Production Areas

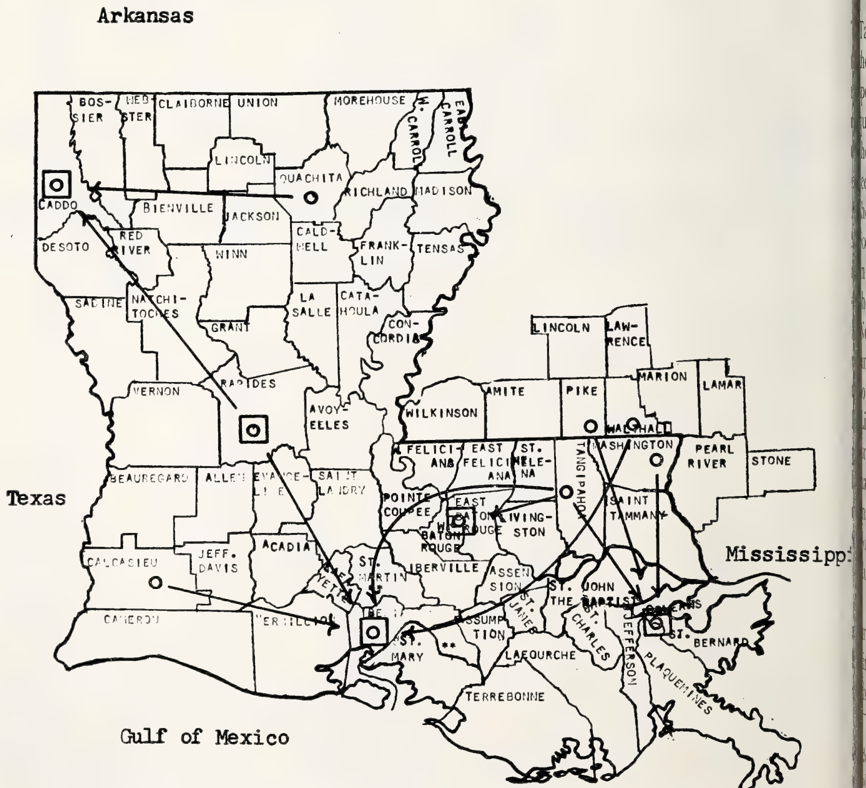
	Marketing Areas				
Production Areas	Northern	Central	Southwest	Southeast	New Orleans
	Dollars per Thousand Pounds				
I	0	2.77	5.21	5.19	6.95
II	2.29	2.01	4.45	4.01	5.78
III	2.77	0	2.44	2.42	4.19
IV	4.05	2.05	2.05	3.01	5.30
V	5.21	2.44	0	2.31	3.25
VI	5.19	2.42	2.31	0	1.77
VII	6.95	4.19	3.25	1.77	0
VIII	6.02	3.92	3.90	1.59	1.87
IX	6.45	4.16	4.08	1.77	2.05
X	5.71	3.62	4.21	1.90	2.18
XI	6.00	3.90	4.66	2.35	2.64

at a fixed point. For example, Shreveport was used to represent th central point for the Northern Louisiana Marketing Area. Shrevepo was also used to represent the central point for Production Area Therefore, there was a zero transfer charge from Production Area I the Northern Marketing Area. However, there was a transfer charge b tween Production Area I and each of the other marketing areas. In ord to determine realistically the total shipping cost of milk from farms t market, an allowance must be made for the cost of getting the milk t the specified central point. This was not necessary, however, in ord to determine the optimum flow of milk from the given production are to the given marketing areas since the cost of assembling milk to the ce tral point would not be changed by, nor affect, the flow pattern.

The Producer-Handler System

In the producer-handler system of distributing producer milk, th supply was assumed to be concentrated at the basing point in the pr duction areas and the demand for Class I milk is represented by, or co centrated at, a central point in the marketing areas. The following a

Figure 7.—Pattern of Flow of Producer Milk by the Producer-Handler System, Bas Forming Period, 1958.[1]



---

[1] This does not show the flow patterns of the alternate distributions which are essentially th same and which are shown in Table IX.

umptions were also made: (1) where basing points for production reas and the central points of the marketing area were identical all milk roduced in such area would be allocated to that area first, up to the olume necessary to fulfill the requirements for Class I sales, and (2) he Class I and the Class II prices in each market were the same as in very other market. The realism of the latter assumption is shown by the act that the State Commissioner of Agriculture was petitioned at a public earing held in Baton Rouge on March 29, 1960, April 1, 1960, April , 1960, and April 20-21, 1960, by the various producer cooperatives of he state, to establish the same minimum price to be paid producers for nilk sold in Class I by handlers in all the marketing areas of the state.[16]

The daily base established by production areas and the daily Class I ales (for the base-forming period of 1958) by marketing areas are shown n Table VI. The optimum distribution (or flow) of producer milk by he producer-handler system for Class I sales is shown in Table IX and n Figure 7.

The estimated minimum cost of transferring the milk from all of the roduction areas to market was $2,402 per day. Solution by the program nodel showed that there were six alternative optima (different distribuion patterns with the same estimated minimum transfer cost of $2,402).

The right hand column and the bottom row under each optimum in able IX shows the total Class I sales requirements by market areas and he total volume of producer milk supplied by each production area, repectively. The cells in the main body of the table, representing the uantity of milk, shows the routing of milk from the production areas to he marketing areas. For example, the number in the cell at the interection of the row for the Southwest Market and the column for Area V hows that 242,000 pounds of milk was shipped from Area V to the outhwest Market. Blank cells indicate that these routes were not used n the optimum distribution. The rows horizontally across the table how the volume and source of supply for each market. For example, the Northern Market received 293 units of milk from Production Area I, 110 nits from Production Area II and 9 units from Production Area III, a otal of 412 units which exactly satisfied the Class I sales' requirements. ikewise, the columns show the market distribution of the milk from each roduction area. For example, under Production Area III, 9 units would ave been shipped to the Northern Market, 78 units would have renained in the Central Market and 11 units would have gone to the outhwest Market. This is a total of 98 units, the amount of milk produced.

As was pointed out previously, when total supply and total demand re not equal it is necessary to use a "dummy" or "slack" variable in a inear programming model. The volume of producer milk was greater han the demand for milk for Class I use; therefore, it was necessary to

---

[16] A state milk marketing order was issued in December 1960 which established dentical minimum prices to be paid to producers by all handlers in the state for milk old in Class I. This order also established a minimum Class II price to all handlers.

Table IX.—Average Daily Optimum Distributions of Producer Milk as Shown by the Producer-Handler System, Louisiana, Base-Forming Period of 1958

Marketing	Production Areas and Volume of Shipments (1,000 Pounds)											
Areas	I	II	III	IV	V	VI	VII	VIII	IX	X	XI	Total
					Alternate Optimum No. 1							
Northern	293	110	9									412
Central			78									78
Southwest			11	49	242			19			54	375
Southeast						128		173				301
New Orleans							31	288	257	152		728
Slack*											119	119
Total	293	110	98	49	242	128	31	480	257	152	173	2,013
					Alternate Optimum No. 2							
Northern	293	110	9									412
Central			78									78
Southwest			11	49	242				19		54	375
Southeast						128		173				301
New Orleans							31	307	238	152		728
Slack*											119	119
Total	293	110	98	49	242	128	31	480	257	152	173	2,013
					Alternate Optimum No. 3							
Northern	293	110	9									412
Central			78									78
Southwest			11	49	242					19	54	375
Southeast						128		173				301
New Orleans							31	307	257	133		728
Slack*											119	119
Total	293	110	98	49	242	128	31	480	257	152	173	2,013

(*Continued*)

Table IX. (Continued)—Average Daily Optimum Distributions of Producer Milk as Shown by the Producer-Handler System, Louisiana, Base-Forming Period of 1958

Marketing Areas	Production Areas and Volume of Shipments (1,000 Pounds)											
	I	II	III	IV	V	VI	VII	VIII	IX	X	XI	Total
					Alternate Optimum No. 4							
Northern	293	110	9									412
Central			78									78
Southwest			11	49	242					19	54	375
Southeast						128			173			301
New Orleans							31	480	84	133		728
Slack*											119	119
Total	293	110	98	49	242	128	31	480	257	152	173	2,013
					Alternate Optimum No. 5							
Northern	293	110	9									412
Central			78									78
Southwest			11	49	242					19	54	375
Southeast						128			40	133		301
New Orleans							31	480	217			728
Slack*											119	119
Total	293	110	98	49	242	128	31	480	257	152	173	2,013
					Alternate Optimum No. 6							
Northern	293	110	9									412
Central			78									78
Southwest			11	49	242					73		375
Southeast						128			40	79	54	301
New Orleans							31	480	217			728
Slack*											119	119
Total	293	110	98	49	242	128	31	480	257	152	173	2,013

*When total supply and total demand are not equal it is necessary to use a "dummy" or "slack" variable in a linear programming model. The volume of producer milk was greater than the demand for milk as Class I use; therefore, it was necessary to use a dummy market. The dummy market was termed slack. The milk allocated to "slack" would be used as Class II.

use a dummy market. The dummy market was termed slack.[17] The e cess volume of milk, 119,000 pounds in each case in the optimum distribu tions, goes from Production Area XI to slack. The disposition of th excess milk will be discussed later.

It is not unique to have several different routings of milk fro origins to destinations with the same minimum total transfer cost. Thes are called alternate optima. Milk from four production areas, VIII, I X, and XI, pass through Hammond in transit to either the New Orlean Southeast or Southwest Markets. Therefore, it is possible to have mor than one combination of routing at the same cost, or alternate optim The primary reasons are: (1) milk from four production areas converge one point in transit to three markets; (2) transfer cost was considered d rectly proportional to distance and independent of volume; and (3) was necessary that milk from four production areas be transferred to th three markets.

In each of the alternate optimum distributions, the milk flowed fro Production Areas I, II, and III to the Northern Market. Part of th supply from Production Area III flowed to Northern, Central an Southwest Markets. Production from Areas IV and V flowed to th Southwest Market. Supplies from Production Area VI moved to th Southeast Market, and supplies from Production Area VII to the Ne Orleans Market. There were six flow combinations for milk from Pr duction Areas VIII, IX, X, and XI to markets in the alternate optim distribution patterns. The corresponding volume of milk flow pattern from the various production areas to the various marketing areas ar shown in Table IX. The 119,000 pounds of excess milk which optimall flowed from Production Area XI to "slack" may be considered a "swin supply." That is, it could go to one of the nearby markets, such as th Central Mississippi or the Mississippi Gulf Coast Markets, for Class sales, if needed. If this were not possible, it could be used as Class II i one of the Louisiana markets.

Contrast of the Producer-Handler and the Current Systems of Milk Distribution

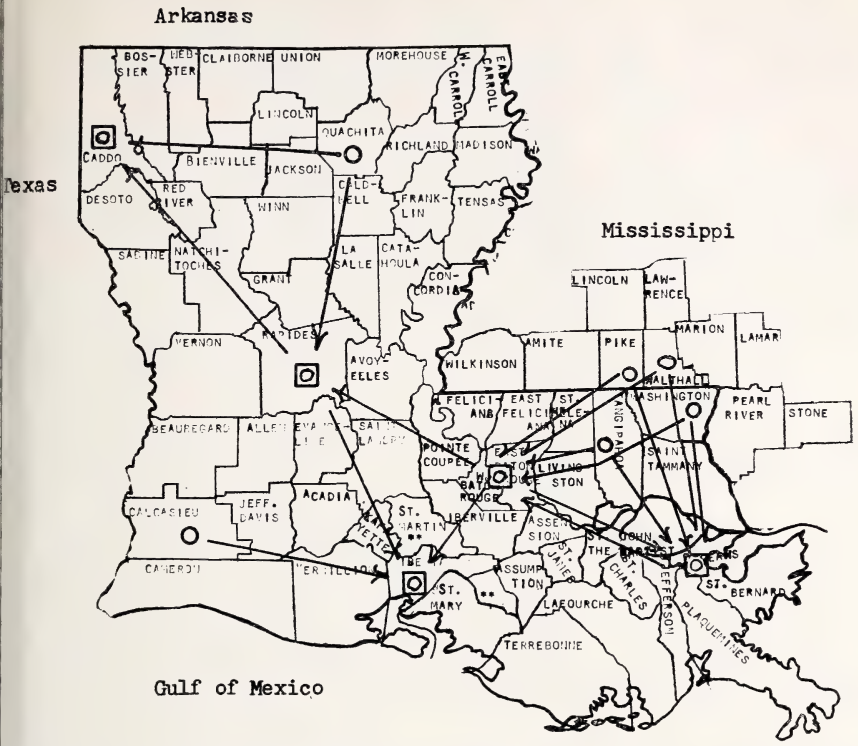
For comparison with the optimum distribution or flow pattern ob tained by the producer-handler system shown in Table IX and Figure 7 the actual flow pattern by the current system of distribution is shown i Table X and illustrated in Figure 8. Under the current and producer handler systems, the flow of milk from Production Areas I, III, IV, an V to marketing areas are the same. However, Tables IX and X sho the volumes moving to the markets are different.

The total estimated transfer cost for the current system of distributin producer milk from the production areas to the marketing areas wa $2,689 per day. The total estimated transfer cost for the producer handler system was $2,402 per day. In the producer-handler system 119,

---

[17] For further explanation of the use of a dummy in transportation models of linea programming, see: Earl O. Heady and Wilfred Candler, *Linear Programming Methods* (Ames, Iowa: Iowa State College Press, 1958), Chapter 10.

Figure 8.—Pattern of Flow of Producer Milk by the Current System, Base-Forming Period, 1958.



00 pounds flowed from Production Area XI to “slack” at a transfer ost of zero because it was left in the production area. Because all of the nilk flowed to the market in the current system of distribution, it was ecessary to move the 119,000 pounds to market for costs to be comparble. It was moved to the nearest market for Class II use at an estimated ransfer cost of $280. This would make the estimated optimum transfer ost $2,682 or slightly less than the estimated actual cost. However, it nust be considered that in the actual flow the Northern, Central, Southvest and Southeast Markets were left deficit while a surplus of 211,000 ounds went to the New Orleans Market for Class II use. Thus, had the ptimum distribution occurred it would have resulted in an average inrease in Class I utilization of producer milk of 92,000 pounds daily. It s necessary then to consider the difference between the Class I and Class II price in order to compute the increase in net revenue. The estinated difference between the Class II and Class I prices was $2.75 per 100 pounds. This difference times the volume of milk shifted from Class I to Class I use (92,000 pounds) plus the difference between the esimated transfer cost for the current system and producer-handler system yields an estimated increase in net returns of $2,537 per day. The net inrease in returns shown is not a result of increasing total Class I sales, out from replacing other source milk used in Class I with producer milk hat was used in Class II.

Table X.—The Average Daily Distribution of Producer Milk to Louisiana Markets by the Current System, Base-Forming Period of 1958

Marketing Areas	Production Areas and Volume of Shipments (1,000 Pounds)											
	I	II	III	IV	V	VI	VII	VIII	IX	X	XI	Total
Northern	293	97	5									395
Central		13	34			1						48
Southwest			59	49	242	1						351
Southeast						123	2	87	34	32	2	280
New Orleans						3	29	393	223	120	171	939
Total	293	110	98	49	242	128	31	480	257	152	173	2,013

COMPARATIVE ANALYSIS OF ALTERNATIVE SYSTEMS

This study suggests that a change in the flow of milk to markets so as to allow maximum Class I utilization of producer milk at minimum transfer cost would be profitable to dairy farmers selling to handlers in Louisiana markets.

Comparison of Distribution Systems

Two possible systems of distributing producer milk in Louisiana were investigated in this study and were compared with the current system. They were: (1) the *inter-handler system,* which shows optimum transfers of producer milk from the handlers in those areas receiving an excess supply of producer milk to other handlers receiving less than their Class I requirements; and (2) the *producer-handler system,* which shows the optimum distribution of producer milk from production points to handlers.

A comparison of (1) the current system, (2) the inter-handler system, and (3) the producer-handler system of distributing producer milk is provided in Table XI. This comparison is made on an average daily basis for the base-forming period of 1958.

Under the current system, producer milk was not distributed among markets in such a way as to allocate the maximum amount of such milk to Class I use. Under the other two distribution systems, producer milk was distributed among markets so as to minimize the cost of transferring the maximum quantity of producer receipts to Class I use. An estimated 92,000 pounds of milk per day could have been shifted from Class II to Class I use during the period.

Effect of Systems on Net Return

By the inter-handler system of distributing producer milk the estimated net increase in returns from such milk over the current system was $2,200 per day or a total of $265,000 for the four-month period. All of this increase would be the result of the shift of producer milk from Class II to Class I use.

The estimated cost of transferring milk under the producer-handler system was slightly less than under the current system. This difference indicates inefficiency created primarily by cross-hauling of milk under the current system of distribution. The combined net increase in returns during the period by the producer-handler system of distribution was estimated at $2,500 daily above the current system and $366 greater per day than by the inter-handler system, or a total of $310,000 and $45,000, respectively, during the four months. The major portion of the increase over the current system was the result of the shift of producer milk from Class II to Class I use and the rest was from savings in transfer cost.

Table V shows that it was not possible to shift as much producer milk from Class II to Class I use during the summer as during the base-forming period. Therefore, the increase in net returns on a yearly basis would not be proportional to the increase during the base-forming period. As was noted earlier, production data were available for individual producers on a parish basis only for the base-forming period of 1958. There-

Table XI.—Comparison of the Current, Inter-Handler and Producer-Handler Systems of Distributing Producer Milk, Base-Forming Period, 1958

Identification	Unit	Average Daily Distribution of Producer Milk		
		Distribution Systems		
		Current	Inter-Handler	Producer-Handler
Total Producer Receipts[1]	Thousand Pounds	2,013	2,013	2,013
Producer Receipts in Class I	Thousand Pounds	1,802	1,894	1,894
Class I Price[2]	Dollars	6.00	6.00	6.00
Producer Receipts in Class II	Thousand Pounds	211	119	119
Class II Price[2]	Dollars	3.25	3.25	3.25
Estimated Total Returns	Dollars	114,978	117,508	117,508
Estimated Total Transfer Cost	Dollars	2,689	3,048	2,682
Estimated Net Returns	Dollars	112,289	114,460	114,826

---

[1] Average daily base established by producers with handlers in Louisiana markets.

[2] It is assumed that the same Class I prices and Class II prices prevailed in all markets.

ore, it was not possible to determine the optimum distribution pattern f producer milk by the producer-handler system for the entire year. Iowever, the optimum distribution of producer milk by the interandler system was determined by months for 1959. This analysis shows hat approximately 13 million pounds of producer milk could have een shifted from Class II to Class I to replace other source milk. The stimated additional returns to local producers resulting from such ptimum allocation pattern would have been $375,000 during 1959. This mount less the total minimum transfer cost of $53,000 shows a net inrease of $322,000 for 1959. Limited observations suggest that, had the roducer milk been optimally distributed by the producer-handler sysem (from production areas to markets), the net increase in returns vould have been even greater.

ffect of Highway System

The highway system in Louisiana had a considerable influence on the ptimum flow pattern derived by the model. For example, by road it was nly a few miles closer to the central points of the Central and Northern arkets from the Southeast than it was from the Southwest Market. As a esult there was only a slight saving in transfer cost by shipping to the entral and Northern Markets from the Southeast rather than from the outhwest Market when both had excess milk. Routes from Production reas VIII, IX, X and XI to the New Orleans, Southeast, and Southwest arkets converge at Hammond, a peculiarity which resulted in six alernative optimum distribution patterns from production areas to marets for the base-forming period of 1958. These peculiarities allow some reedom of choice and yet permit optimum distribution of producers' ilk among markets. However, changes in such conditions would not reuce the usefulness of the model in determining the optimum distribuion.

Such changes as mileage between origins and destinations, transfer ates, relation of producer receipts to Class I sales in the various marets and changes in supply and/or demand would affect the flow pattern. ut, with the applicable data the optimum distribution could still be etermined through use of the model.

he Better Alternative

A change in the flow of producer milk by the producer-handler sysem appears to be the more remunerative of the two changes investigated. t also appears to be the more logical of the two changes for the following easons: (1) Handlers are required to pay for milk according to the use ade of it. Therefore, handlers do not usually lower their cost by using ther source milk rather than producer deliveries for their Class I sales. (2) A handler receiving an excess of producer milk probably would not ransfer the milk to other handlers solely to increase the quantity of proucer milk going into Class I use if he could profitably utilize the excess milk for Class II products unless some provisions were made to pay im for the transfer. Therefore, the responsibility and initiative for aximizing the Class I use of producers' milk would more logically fall upon the producers acting through producer cooperatives qualified law to market their members' milk. The incentive for producers to p form this service likely would be greater than that of the handlers.

Changes Needed in Institutional and Other Barriers

Some institutional and other obstacles may have to be removed bef such a change in the flow pattern of milk in the state could take pla Among these are: (1) It may be necessary to consider the state as milk marketing area instead of five, or to make some changes in curr regulations under which these markets are operating. Diversion privile and methods of calculating base pounds may need to be changed so to allow milk to move freely to plants where needed for Class I use. (2) the state is still divided into five marketing areas instead of one, it may necessary to allow a location differential for movement of producer m between markets for Class I use. That is, if a producer association handler diverts producer milk from one market to another, a reducti in the producers' Class I price by an amount to cover the transfer c might facilitate the optimum movement of milk. (3) Producers now ceiving a relatively high Class I utilization may receive a lower Clas utilization and thus a lower blend price as a result of such a change the flow of milk (especially in a market wide pool) if the state is co sidered one market. Thus, it may be necessary to develop an equita method of payment to producers which would give consideration to cation of the producer's farm in relation to pricing point for the mark This method may require establishment of price zones with location d ferentials to be applied to the location of the farm rather than to ceiving stations.[18]

However, if the milk were optimally distributed, as shown by t model, the producers in a deficit market would still receive the same p centage Class I utilization, provided their total production remained u changed in relation to Class I sales. The reason is that only enough pr ducer milk would flow to the deficit market to fill the needs for Class use. This transfer would result in a greater Class I use of total produc milk from excess markets. But, if the same flow pattern as shown fro production area to markets for the base-forming period were used on yearly basis, producers now supplying deficit markets would probab receive a lower percentage Class I utilization during flush producti periods. Further study of these factors may reveal that they are not se ous obstacles at all, or that they could be overcome with relative ease.

It may require central control action to direct the movement milk from farm to market as proposed by the optimum distribution pa tern. There are at least two possible methods for accomplishing this o jective. One is to assign producer deliveries to specific handlers on th basis of the base-forming period for an entire year. Another would be allocate deliveries to handlers by bulk tank routes and change the di tribution pattern as the relationship of producer receipts and Class ales change. It appears that the net increase in returns possible from ptimum distribution of producer milk among markets would be suf- ciently large to induce producer cooperatives to attempt the change. But, nodification of the current flow pattern will require a change of pro- ucer-handler relationships.

---

[18] Differences in farm prices for milk originating at different distances from t market. The price f.o.b. handlers plants would not be affected.

In order to obtain optimum distribution it may be necessary for pro- ucer cooperatives to obtain full supply contracts[19] with all handlers, or t least a willingness of handlers and producers to work together toward btaining optimum distribution. Close cooperation among the producer ooperatives would be necessary. And, it may be necessary for them to ederate and/or function as one cooperative in order to accomplish the roposed distribution system.

APPENDIX

Algebraic Presentation of the Formal Assumptions of the Transportation Model

Where the objectives are to minimize transfer costs, given the speci- ed requirements at destinations and amounts available at specified rigins of a homogeneous commodity, it is necessary to know the ollowing: (1) the amount available at each origin (Sj), (2) the amount equired at each destination (Di) and the unit transfer cost (Cij) from ny origin (j) to any destination (i). The optimum allocation is ob- ained when the following conditions are met:

$$(1)\quad \text{Minimize}\ Z_0 = \sum_{i=1}^{M} \sum_{j=1}^{N} C_{ij}\, X_{ij}$$

Subject to the restrictions.

$$(2)\quad D_i = \sum_{j=1}^{N} X_{ij}$$

$$(3)\quad S_j = \sum_{i=1}^{M} X_{ij}$$

$$(4)\quad \sum_{i=1}^{N} D_i = \sum_{j=1}^{M} S_j$$

$$(5)\quad X_{ij} \geq 0$$

Equation (1) states that Z_0 is the minimum total transfer cost, Cij the cost of transferring a unit of commodity from origin j to des- nation i and Xij is the amount of product transferred from origin j to destination i. Destinations j = 1, ... , N and origins i = 1, ... , The objective is to minimize the aggregate sum of products formed multiplying the costs of transferring each unit of product by the amou of product transferred between the same areas. The transfer cost u in this study was 2.18 cents per mile per 1,000 pounds of milk hauled

---

[19] A full supply contract is where producer cooperatives contract with handlers to ipply them all the milk they need and only the amount they need. Under this ar- ingement handlers are assured of a supply of milk and do not have the problem of isposing of surplus milk.

Equation (2) states that the sum of quantities transferred from various origins to the i - th destination, $\sum_{j=1}^{N}$ Xij, must equal to requirements, Di, of the i - th area. The volume of milk shipped fr the various supply areas to a specified market must equal the dema for milk in the market.

Equation (3) states that the sum of quantities transferred from th origin to the several destinations $\sum_{i=1}^{M}$ Xij, must equal the supply product, Sj, available at the j - th origin. In other words the volu of milk shipped from any specified supply area to the various alternat destinations must equal the supply of milk in the supply area.

Equation (4) states that the total requirements, the sum of the quirements of the different destinations, must equal to the total qua tity supplied, that is, the sum of the supplies at the different origins.[20]

Equation (5) states that transfers between areas cannot be carried at negative levels.

---

[20] In situations where aggregate supply does not equal aggregate demand, for requirements of the model are met by the use of "slack" variables. In this study, gregate supply was greater than aggregate demand, therefor, a "slack" variable used to account for the difference.

Research . . .
Key to Progress

567
E56b

Resource Use and Adjustment Potential:

Rural Families in the Central Louisiana Mixed Farming Area

~~Henderson~~
~~Hausen~~
Stucker

BILL BOLTON

LIBRARY
DEC 2 1963
NEW MEXICO STATE UNIVERSITY

SURPLUS
TO REQUIREMENTS AS
Superseded
Worn out
Obsolete
Unbindable
Duplicated
NMSU LIBRARY
LAS CRUCES

June 1961
Bulletin No. 545

Louisiana State University
and
Agricultural and Mechanical College
Agricultural Experiment Station
Charles W. Upp, Director
In Cooperation With
Farm Economics Division
Economics Research Service
United States Department of Agriculture

Table of Contents

Pa

INTRODUCTION . . . 3
    Source of Data . . . 3
    The Area and the Population . . . 3
    Basis for Family Grouping . . . 5
    Definitions . . . 8

FAMILIES OBVIOUSLY WITHOUT AN INCOME PROBLEM . . . 9
    Owners of Large Properties . . . 9
    Owners of Small Properties . . . 12
    Nonfarm Employment of Head or Wife: Farm Families . . . 13
    Nonfarm Employment of Head or Wife: Nonfarm Families . . . 13
    Characteristics of Families With Male Heads Earning $2,000 . . . 14
    Family Income . . . 16
    Adjustment Potential . . . 18
    Family Members Who Had Left Home . . . 19

FAMILIES WITH OBVIOUSLY LIMITED ADJUSTMENT POTENTIAL . . . 20
    Nonfarm Families with Heads Receiving Transfer Payments . . . 22
    Farm Families With Heads Receiving Transfer Payments . . . 22
    Families With Primary Source of Income From Property . . . 23
    Family Income . . . 23
    Adjustment Potential . . . 23
    Family Members Who Had Left Home . . . 26

FARM FAMILIES PRIMARILY DEPENDENT ON FARMING . . . 27
    Farm Families Operating Small Farms . . . 27
        Summary of Adjustment Potential of Families On Small Farms . . . 38
    Farm Families Operating Medium-Size Farms . . . 39
    Farm Families Operating Large Farms . . . 45
        Summary of Adjustment Potential of Families On Medium-Size and Large Farms . . . 47

FARM LABORER FAMILIES . . . 50

MISCELLANEOUS FAMILIES . . . 52

SUMMARY . . . 53
    Family Members Who Had Left Home . . . 53
    Family Members Still at Home . . . 55
    Existing Families . . . 56

CONCLUSIONS . . . 59

APPENDIX . . . 63

Resource Use and Adjustment Potential: Rural Families in the Central Louisiana Mixed Farming Area

BILL BOLTON[1]

Introduction

This is a second report resulting from the research project entitled “An Economic Appraisal of the Characteristics and Problems of Low ncome Farm Families in the Central Louisiana Mixed Farming Area.” The research reported was part of the Rural Development Program inaugurated in 1956 by the President of the United States.

The first report[2] presented data on the relation of income to various arm and population characteristics. The purpose of the second report s to describe more specifically groups of rural families with respect to ncome problems, resource use and availability, and potential for making adjustments to increase farm or nonfarm income.

Source of Data

Data for the study were obtained in a survey of 576 rural households n the Central Louisiana Mixed Farming Area, composed of Avoyelles, Evangeline, Lafayette, Pointe Coupee and St. Landry parishes. Avoyelles Parish was one of the “pilot counties” in the Rural Development Program. A probability area sample was used in selecting households to be included in the study. Most of the data pertain to the calendar year 1956.

The Area and the Population

Five major soil divisions occur in this five-parish area. The soils of more than half of the area, on the north and east, are predominantly Red River and Mississippi River bottom soils. A strip of loessial terrace soils runs through the center of the area from northwest to southeast. Coastal prairie soils predominate in the western part of the area. Small amounts of coastal plains and flatwoods soils occur in the northwestern part. Fertility ranges from excellent to poor.

The topography of the area is typically flat to gently rolling.

---

[1] Agricultural Economist, Farm Economics Division, Economic Research Service, United States Department of Agriculture.

[2] *Income and Related Characteristics of Rural Households in the Central Louisiana Mixed Farming Area,* Department of Agricultural Economics Circular 257, Louisiana Agricultural Experiment Station, March 1960. Agricultural Research Service, United States Department of Agriculture, Cooperating.

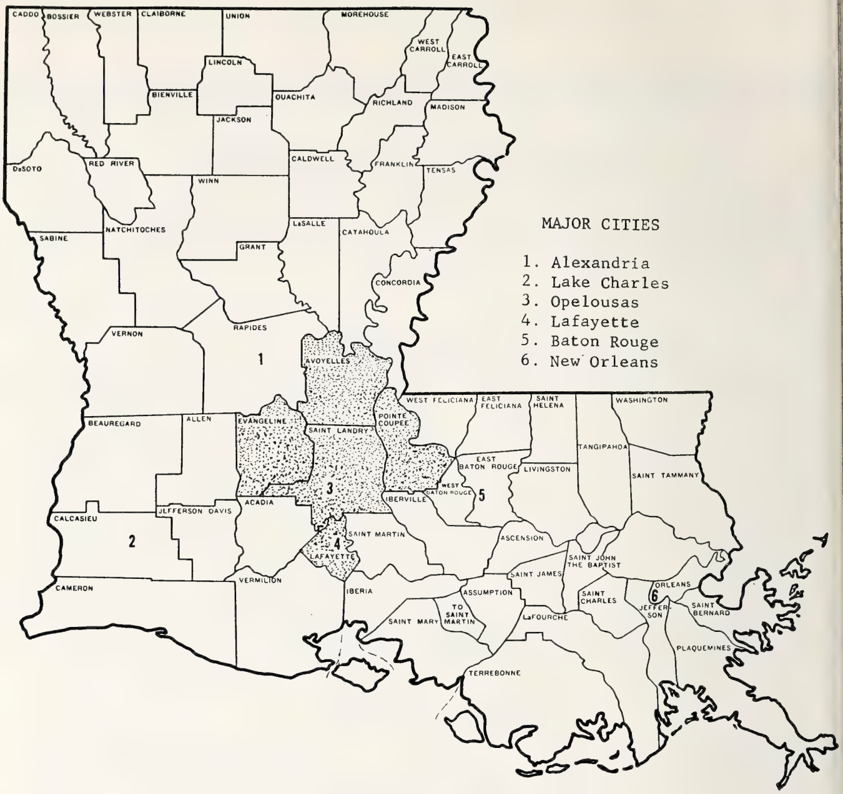


FIGURE 1.—Location of the Central Louisiana Mixed Farming Area

In 1954, the total value of farm products sold was approximately $5 million for the five-parish area.[3] Eighty-seven percent of this amoun was from the sale of crops. Cotton is the major farm enterprise throug out the area. Sugarcane is produced in the eastern and southern parts and rice in the southwestern part of the area. Sweetpotatoes are an im portant farm enterprise, particularly in the central and southern parts o the area. Livestock are kept on most farms, but specialized livestock en terprises usually are limited to the very large farms.

Of the almost one-fourth of a million persons in the area in 195 31 percent were urban residents, 27 percent rural nonfarm residents, an 42 percent rural farm residents. Between 1940 and 1950, total popula tion increased by 15,000 with most of the gain occurring in Lafayett and St. Landry parishes. During this period, the rural farm populatio lost 34,000 persons, the rural nonfarm population gained 22,000 persons and the urban population gained 27,000 persons. It is estimated tha there was a net migration of 36,000 persons from the five parishes during this period.[4]

---

[3] *Census of Agriculture, Louisiana 1954,* Bureau of the Census, United States De partment of Commerce.

Negroes accounted for about 35 percent of the total population in 1950. The number of Negroes remained about constant between 1940 and 1950, but the net migration out of the area was estimated to be considerably higher for Negroes than for whites.

There are only two cities of more than 10,000 population in the area: Opelousas, in St. Landry Parish, with about 12,000 people in 1950, and Lafayette, in Lafayette Parish, with a population of about 34,000 in 1950. But there are several cities near the area. Alexandria, with a population of about 35,000 in 1950 is approximately 25 miles to the north; Baton Rouge, a city of 126,000 people in 1950, is about 20 miles to the east; and Lake Charles, with a population of 41,000 in 1950, is about 60 miles to the southwest. New Orleans, with a population of more than a half million, is slightly more than 100 miles to the southeast. Between 1940 and 1950, the following population increases occurred: Opelousas—30 percent, Lafayette—75 percent, Alexandria—29 percent, Baton Rouge—262 percent, and Lake Charles—95 percent.

In 1956, the five-parish study area had approximately 26,500 nonfarm employees subject to the old age and survivors insurance tax, employed by about 2,900 businesses. Taxable payrolls totaled about $54 million. Slightly more than three-fourths of these persons were employed in Lafayette and St. Landry parishes. There were also many self-employed persons, proprietors, and others not covered by old age and survivors insurance. In 1956, East Baton Rouge Parish had 49,000 employed persons in this category, Rapides Parish (site of Alexandria) had 14,000, and Calcasieu Parish (site of Lake Charles) had 25,000.[5]

Although the data for the two years are not exactly comparable, a comparison of numbers of persons covered by old age and survivors insurance in 1946 and in 1956 gives some indication of the relative growth in the various areas. For the five-parish area, there was an increase of slightly more than 100 percent. Lafayette parish had an increase of 146 percent, and the other four parishes had an average increase of 74 percent. Over the same period, East Baton Rouge Parish had an increase of 125 percent, Rapides Parish had an increase of 23 percent and Calcasieu Parish an increase of 79 percent.

Basis for Family Grouping

Income problems and adjustment potential for *existing families* in the sample, as distinct from individual family members, are considered in terms of family heads and wives. Therefore, the employment of other family members was ignored in developing the major family grou that follow.

---

[4] *Census of Population, Louisiana 1950 and 1940,* Bureau of the Census, United States Department of Commerce.

[5] *County Business Patterns,* Louisiana 1956 and 1946, United States Department of Commerce.

In order to delineate the magnitude of the rural low income proble in the Central Louisiana Mixed Farming Area, and to facilitate discu sion of adjustment potentials, two large groups of rural families we isolated from the rest of the sample. These are (1) families defined not having a major income problem, and (2) families defined as havi very limited adjustment potential. This permits movement from the families to a closer examination of the remaining families, who may may not have an income problem *and* who may or may not have potential for increasing income.

Families are defined as having no major income problems if t family head or wife had stable nonfarm employment from which $2,0 or more was earned during the year, or if the family received $2,0 or more income from property ownership. This group is heterogeneo from the standpoint of family characteristics, resources owned, a farming activity. Families in the group have one thing in common: t family-decision-making center received $2,000 or more income fro nonfarm, nontransfer payment sources. The $2,000 yearly income is n to be interpreted as representing a standard to be attained. Some incon level was required as a basis for grouping, and $2,000 was chosen considerably above the level received by a large proportion of famili in the area, yet within "striking distance" of those receiving lower i comes.

The group of families with obviously limited adjustment potenti is somewhat harder to define. Families were placed in this group p marily because of some characteristic of the family head. Practically a family heads in the group were elderly males; disabled males; or femal usually elderly and usually with limited education. In general, the fam lies in the group occupied a retired or semiretired status. The prima source of income to all family heads in the group was transfer pa ments[6] or small property incomes (under $2,000). In general, those wi property incomes would have been transfer payment recipients in t absence of the property incomes. In a few instances, the receipt transfer payments, together with attitudes expressed by the family hea was accepted as indication that the family would make no income-ge erating adjustments. In all families, the likelihood of any income-increa ing adjustment resulting from efforts of family heads or wives seem to be virtually zero.

Rural families remaining after the two groups described above a removed from the sample fall into three distinguishable categories: (farm families primarily dependent on farming for a livelihood; (2) far aborer families; and (3) miscellaneous nonfarm families that do not it either the "no income problem" or "no adjustment potential" definiion. Of the three groups, the farm families primarily dependent on arming are of major interest in this report.

---

[6] Transfer payments are defined as including all income not resulting from a productive effort on the part of the recipient or from property ownership. Th include welfare payments, military pensions, social security benefits, other publ assistance, and small amounts directly transferred between individuals.

Each of the five major groups of families described above was further ubdivided for purposes of the study. Following is a summary of the roupings used in the study, together with the number and percentage f sample families in each of the major groups, and the number in each ubgroup:

1. Adjustment Potential Group I. Families obviously without a major income problem (134 families, 23 percent of sample)
   A. Property income of $2,000 or more (22 families)
      (1) Large property owners—500 acres or more (6 families)
      (2) Small property owners—Less than 500 acres (16 families)
   B. Stable nonfarm employment income of $2,000 or more to head or wife (112 families)
      (1) Farm families (50 families)
      (2) Nonfarm families (62 families)
2. Adjustment Potential Group II. Families with obviously limited adjustment potential (145 families, 25 percent of sample)
   A. Major source of income from transfer payments (116 families)
      (1) Nonfarm families (75 families)
      (2) Farm families (41 families)
   B. Major source of income from property (29 families)
3. Adjustment Potential Group III. Farm families primarily dependent on farming (excluding farms in Groups 1 and 2), (248 families, 43 percent of sample)
   A. Less than 30 acres of cropland or less than 50 acres of total land, or both (177 families)[7]
      (1) Nonowner families (118 families)
         (a) Less than $250 nonfarm employment income to family head (101 families)
         (b) More than $250, but less than $2,000, nonfarm employment income to family head (17 families)
      (2) Owner families (59 families)
         (a) Less than $250 nonfarm employment income to family head (38 families)
         (b) More than $250, but less than $2,000, nonfarm employment income to family head (21 families)
   B. Thirty to 50 acres of cropland, or 50 to 100 acres of total land, or both (45 families)[8]
      (1) Nonowner families (30 families)
      (2) Owner families (15 families)

---

[7] Defined as too small to sustain a farm income of $2,000.

[8] Defined as large enough to approach a farm income of $2,000.

C. Fifty or more acres of cropland or 100 or more acres of tot land, or both (26 families)[9]
    (1) Nonowner families (10 families)
    (2) Owner families (16 families)

4. Adjustment Potential Group IV. Farm laborer families (27 fam lies, 5 percent of sample)
5. Adjustment Potential Group V. Miscellaneous nonfarm famili (22 families, 4 percent of sample)

On the fringe of almost every group were a few families that cou have been placed in some other group. For example, a few of the famili with more than $2,000 nonfarm employment income also received rel tively large property incomes. Among families classed as receiving mo of their income from property, a few also received transfer payment and vice versa. A few of the farm operators who had part-time off-far employment had combined incomes from farming and off-farm en ployment of $2,000. However, of the many groupings attempted, th one used seemed to reflect most adequately level of income, source c income, and adjustment potential, within the limitations of the numbe of observations available.

Definitions

Certain computed figures are used in the tables and discussion rel tive to each of the family groups. Some of these figures require explan tion.

Unused open land is computed by allowing two acres for eac mature-cow equivalent and subtracting this requirement from th amount of open land not in crops. Unused land is not to be confuse with underutilized land. Actually, two acres per animal might represen underutilization. It is certain that, for most groups, some of the lan in crops is underutilized in terms of returns obtained.

Certain *returns* figures are shown in each of the land availability an use tables. It must be emphasized that these returns figures *are no* intended to represent an efficiency analysis. They are included only a a reflection of the intensity of land use by the various groups.

Total receipts include the share of farm receipts to both operato and landlord. It is the total value of farm produce from a given farn including farm-produced food.

Farm income is operator's cash farm receipts minus operator's cas farm expenses and depreciation on buildings and equipment owned.

Farm earnings is farm income plus the value of farm-produced foo consumed by the family.

Property income is all income resulting purely from property owner ship, farm or nonfarm. It includes income from farm land rented ou (less any expenses incurred), mineral leases and royalties, rent from houses owned, and other similar items.

---

[9] Defined as large enough to earn a $2,000 farm income on a sustained basis.

Labor availability is computed on the basis of a 40-hour week, or in erms of the equivalent of a full-time work year of 2,080 hours. This is he figure toward which most full-time nonfarm employment tends. It is onsiderably below the figure generally used to reflect the availability of farm labor. However, the assumption of a 9- or 10-hour day and a 6-or 7-day week is as unrealistic for farm labor as for nonfarm labor, not only because of the seasonal nature of farm work, but also because of the lack of willingness on the part of any large group to work such hours.

Males and females over 14 and under 65 years of age, not in school, were assumed to have a full-time labor equivalent unless a physical disability was indicated. Family members over 14, but in school, were assumed to have 0.3 full-time equivalent of labor available. Children 10 to 13 years of age were assumed to have 0.2 full-time equivalent of labor available.

Farm labor requirements were computed on the basis of crops and livestock reported, yield of crops, level of mechanization, and amount of farm labor hired. Hired farm labor was credited at 49 cents per hour, the average wage rate reported for all farms in the sample. The labor requirements used for the various crops and livestock are shown in Appendix Table 1.

Families Obviously Without a Major Income Problem

Families obviously without a major income problem (Group I families) accounted for about 23 percent of all families surveyed. To facilitate discussion of resource control and use, the 134 families in the group have been further divided into four subgroups. These are: (1) large property owners whose primary source of income was property; (2) smaller property owners whose primary source of income was property; (3) farm families whose primary source of income was nonfarm employment; and (4) nonfarm families whose primary source of income was nonfarm employment. Each of the subgroups is discussed separately in this section, followed by a discussion of the major group as a whole.

Owners of Large Properties

Six families in Group I owned 500 acres or more of land and received property incomes of $2,000 or more. These families made up slightly more than one percent of the sample They owned about 53 percent of all land owned by sample families and operated about 43 percent of the land. A comparison with census data, however, suggests that this group is slightly overrepresented in the sample.

Land Use: Indications are that about half of the open land operated by these families was unused (Table 1). Gross value of production, including the value of farm privileges, amounted to less than $20 per acre of open land. Net returns amounted to less than $4 per acre. It should

TABLE 1.—Land Availability and Use, Rural Families Obviously Without A Major Income Problem[1]

Item	Unit	Major income source: property		Major income source: nonfarm work	
		Owned 500 acres or more	Owned less than 500 acres	Farm families	Nonfarm families
Number of families		6	16	50	62
			Average per family		
Land owned	Acres	2,392	132.1	55.3	8.8
Land rented in	Acres	13	8.1	18.0	..
Land rented out	Acres	168	67.4	16.9	8.0
Land operated	Acres	2,237	72.8	56.4	.
Open land	Acres	1,624	57.9	33.9	..
Crops	Acres	318	19.7	9.0	.
Cash Crops	Acres	166	16.9	4.5	.
Idle cropland & pasture	Acres	1,306	38.2	24.9	.
Unused open land	Acres	765	2.2	4.1	.
Rent:					
Per acre of open land rented in	Dollars	33.49	17.16	9.05	.
Per acre of open land rented out	Dollars	43.19	28.68	14.93	11.16
Total receipts per acre of open land operated	Dollars	18.00	40.00	61.00	..
Farm income per acre of open land operated	Dollars	3.25	—2.81	—2.86	..
Farm earnings per acre of open land operated	Dollars	3.97	6.97	10.77	..

---

[1] See pages 6-7 for definition of these families.

TABLE 2.—Labor Availability and Use, Rural Families Obviously Without A Major Income Problem[1]

Item	Major income source: property		Major income source: nonfarm work	
	Owned 500 acres or more	Owned less than 500 acres	Farm families	Nonfarm families
Number of families	6	16	50	62
	.... Average hours per family			
Male heads:				
Available	1,907	1,495	2,039	1,963
Nonfarm work	....	250	1,976	2,046
Farm wage work	....	....	....	5
Female heads and wives:				
Available	2,080	1,820	1,976	2,046
Nonfarm work	....	170	170	178
Farm wage work	....	....	....	3
Other males over 14:				
Available	1,248	936	553	335
Nonfarm work	....	130	159	91
Farm wage work	....	14	...	7
Other females over 14:				
Available	458	572	379	148
Nonfarm work	173	....	42	10
Farm wage work	....	....	....	9
Children 10-13:				
Available	69	152	250	161
Hours remaining:				
Male heads	1,907	1,245	63	—88
Female heads & wives	2,080	1,650	1,806	1,865
Other males	1,248	792	394	237
Other females	285	572	337	129
Children 10-13	69	152	250	161
Total hours used for farm work	....	1,203	722	....

---

[1] See pages 6-7 for definition

be pointed out, however, that farm returns are somewhat understate for this group, while rent received is overstated. On some of the farms there were two or three tenure arrangements on the same far in addition to farming operations carried on with wage labor. As result, it was not always possible to allocate expenses between the te ants' operations and the landlord's operation. For these farms, gro rent was reported and expenses on the land rented out were include with the landlord's expenses. However, this makes little difference i the general conclusion that land operated by these families was use at a relatively low level of intensity.

Labor Use: Practically no off-farm work was performed by membe of these families (Table 2). For the subgroup as a whole, more farm labo was hired than seemed necessary for the enterprises reported. In genera work performed by family members apparently was in a supervisory ca pacity.

Capital: The average net worth per family was about $500,000. Th average value of farm assets used was $427,000, of which about $75,00 was in machinery and livestock.

Owners of Small Properties

Sixteen families in Group I owned less than 500 acres and receive property income of $2,000 or more. These families made up about percent of the families in the sample. They owned about 8 percent o the land in the sample and operated about 4 percent. All male famil heads were over 45 years of age and more than half were over 55.

Land Use: Only about 4 percent of the open land operated by thes families was unused, in terms of the definition based on land use b livestock (Table 1). In terms of gross product, however, the land wa considerably underutilized. Gross value of farm products, including th value of farm privileges, amounted to only $40 per acre. Average far income to these families per acre was very small. These returns woul have been considerably smaller if a charge had been made for capital The largest farm income reported on any of these farms was $1,206. Fo these farms, although to a lesser extent than for the larger farms, ren received is slightly overstated and farm income slightly understated but not by enough to make an appreciable difference in returns to lan operated.

Labor Use: Three of the male family heads had some nonfarm work One had a home auto-repair service; one did some custom hauling; an one worked part-time at drilling water wells. Two wives worked in schoo lunch rooms.

On these farms, there was an average of approximately one full-tim equivalent of male labor available for farm work and slightly more tha a full-time equivalent of female and child labor available (Table 2) Slightly more than one-half full-time equivalent of farm labor was performed by family labor.

Capital: The families averaged a net worth of approximately $42,000. They used farm assets valued at $28,000, of which about $5,000 was in livestock and machinery.

Nonfarm Employment of Head or Wife: Farm Families

Of the Group I farm families with heads or wives receiving $2,000 or more income from off-farm employment, 50 were farm families by census definition. Families were placed in this group or in the similar nonfarm group, only if the employment seemed relatively stable.

These families made up about 9 percent of the families in the sample. They owned about 10 percent of the land and operated about 9 percent.

Land Use: Almost half the land was owned by four families. About one-eighth of the open land was unused (Table 1). The level of intensity of land use was low. The gross value of farm products per acre of open land operated was $61, but about half of this value resulted from two farms with large poultry flocks. Excluding poultry products, the gross value of product amounted to only $34 per acre of open land, of which more than half was due to farm privileges. Net returns per acre of land were low. Only three families, of which two were those with the large poultry enterprises, had farm incomes of more than $1,000. The largest farm income was reported by a family that had a large poultry enterprise and also owned a feed business.

Labor Use: Available labor of male family heads was almost completely utilized at nonfarm work at an average wage of $13.87 per day (Table 2). One elderly head with a young working wife was unemployed.

Four of the 48 wives had full-time nonfarm employment at an average of $2,875 per year. Employment of all other wives averaged less than one day for the year. Working wives were employed at teaching, clerical, and machine operator jobs.

An average of slightly more than the equivalent of one-third year of full-time farm labor was performed by family members on these farms, more than three-fourths of it livestock chore labor.

Capital: The average net worth of families in this subgroup was about $30,000. The average value of farm assets used was $22,335, of which $2,769 was in livestock and machinery. These financial items varied widely among families.

Nonfarm Employment of Head or Wife: Nonfarm Families

There were 62 nonfarm families in Group I who received $2,000 or more from nonfarm employment of heads or wives. These families accounted for about 11 percent of the families in the sample. They owned about 2 percent of the land, most of which was rented out.

Land Use: About four-fifths of the land owned by this group was owned by four families. Rent received per acre for land rented averaged less than that received by families in the other subgroups because most of this land did not have cotton or rice allotments associated with it.

Labor Use: The labor of male heads in these families was slight more than fully utilized on the basis of a 40-hour week. One male hea in the group was disabled and did no work. For another, who establishe a household during the year, only part of the year was reported.

Two female family heads in the group had full-time nonfarm en ployment. Two wives also worked full time. All other wives had a tot of 350 days of part-time work. Full-time jobs reported were teache store clerk, secretary, and grocer. Part-time jobs reported include clerical and stenographic work and cooking.

Characteristics of Families With Male Heads Earning $2,000

Families receiving $2,000 or more income from off-farm work family heads are not considered, for purposes of this report, to have major income problem. An examination of some of the characteristi of the male family heads, however, may provide some insight into th possibility of nonfarm employment adjustments by families in othe groups.

Of interest is the low representation of some classes among thes families as compared with their representation in the total rural popul tion. For example, of the male heads in the group, only one-eighth wer over 55 years of age, and only one-fifth had completed less than 5 yea of school. Of the families classed as farm families, only 6 percent owne no farm property, that is, were purely renters. Not only were ther relatively few renters, but the nonfarm employment income of rente was generally below that received by others in the subgroup. The averag nonfarm employment income received by male heads for the entir group was almost $3,700 per year. Heads of Negro families average about $2,900, heads over 55 years of age averaged $2,750, and head with less than 5 years of school averaged slightly more than $3,000.

Also of interest is the type of activity in which these nonfarm worke were engaged. Types of employment, by age and by education categorie and average incomes received are shown in Table 3.

The proportion of workers in the unskilled, semiskilled and skille labor groups decreased as education increased (Table 3). There is n clear relationship between age and type of employment.

Distribution of these workers by source of employment is shown i Table 4. About a third were self-employed persons, mostly proprieto of retail or wholesale establishments. With the exception of constructio concerns, most of the employing agencies were considered to be stabl employment sources. However, the relatively low employment by in dustrial concerns provides a relatively low base for expansion of nonfar employment. At least a part of the industrial employment was on th fringe of or outside the area.

It is generally assumed that most adjustment from farm to nonfar employment will occur at the younger ages. This appears to have bee generally true for the nonfarm workers in these families (Table 5). Ther

TABLE 3.—Types of Employment of Male Heads of Group I Families Who Had $2,000 or More Nonfarm Employment Income, by Age and by Education

Occupation	Number	Average wage	Years school completed			Age			
			Under 5	5-8	9 or more	Under 35	35-44	45-54	55 or over
			Number						
Proprietor or manager	27	$ 3,693	4	11	12	7	9	5	6
Operative[1]	19	3,647	7	8	4	5	7	5	2
Craftsman[2]	33	3,652	6	20	7	12	8	10	3
Laborer	12	2,576	5	7	..	4	4	2	2
Salesman	4	3,438	..	2	2	2	1	1	..
Professional	6	6,267	..	..	6	2	3	1	..
Miscellaneous[3]	6	3,937	..	2	4	2	3	1	..
Total	107		22	50	35	34	35	25	13

---

[1] Semi-skilled class—truck driver, machine operator, etc.
[2] Skilled—carpenter, brick mason, etc
[3] Warehouseman, clerk, artificial breeding technician, service repair man, etc.

TABLE 4.—Source of Employment of Male Heads of Group I Families Who Earn $2,000 or More Income from Nonfarm Work

Employment agency	Number	Percent
Self-employed	26	24.2
Construction concerns	22	20.6
Industrial products concerns	16	15.0
Government	11	10.3
School system	6	5.6
Wholesale-retail concern	8	7.5
Oil company	4	3.7
Dredging concerns	4	3.7
Railroad and utility	3	2.8
Service company	2	1.9
Miscellaneous[1]	5	4.7
Total	107	100.0

[1]Merchant marine, insurance company, sawmill, etc.

TABLE 5.—Age and Farm Background of Rural Male Heads of Group I Famili Who Earned $2,000 or More Income from Nonfarm Work

		Age			
Item	Number	Under 35	35-44	45-54	55 and ove
Farm Families:			Number		
Never farmed full-time	22	5	6	6	5
Had farmed full-time	27	3	12	8	4
Age stopped full-time farming					
Under 25	(1)		(1)		
25-34	(14)	(3)	(9)	(1)	(1)
35-44	(7)		(2)	(4)	(1)
45-54	(5)			(3)	(2)
Total	49	8	18	14	9
Nonfarm families:					
Never farmed	34	18	8	4	4
Had farmed	24	8	9	7	..
Age stopped farming					
Under 25	(10)	(5)	(4)	(1)	
25-34	(9)	(3)	(4)	(2)	
35-44	(4)		(1)	(3)	
45-54	(1)			(1)	
Total	58	26	17	11	4

were no workers who had shifted from farming to nonfarm employmen after 55 years of age. Of 12 part-time and residential farmers over 45 who had been full-time farmers, 5 had taken nonfarm employment between ages 45 and 54. Of seven nonfarmers over 45 who had farmed, only one shifted to nonfarm work after 45. The majority of shifts to nonfarm employment occurred before age 35.

Family Income

Total family incomes for the four subgroups of families not considered to have major income problems are shown by major source of

TABLE 6.—Income of Rural Families Obviously Without A Major Income Problem[1]

Income source	Major income source: property		Major income source: nonfarm work	
	Owned 500 acres or more	Owned less than 500 acres	Farm families	Nonfarm families
Number of families	6	16	50	62
	Dollars per family			
Work of male heads	....	275	3,424	3,606
Work of female heads and wives	....	83	230	195
Property income	10,155	3,876	716	207
Transfer payments	....	220	53	106
Farm income	5,273	—163	—97	
Value of farm privileges	1,174	568	462	77
Total	16,602	4,859	4,788	4,191
Work of other family members	100	317	257	132
Total family earnings	16,702	5,176	5,045	4,323
	Dollars per capita			
Per capita earnings	3,854	1,563	1,213	996

---

[1] See pages 6-7 for definition.

income (Table 6). All four subgroups averaged incomes of more tha $4,000.

Incomes of typical farm and nonfarm families in which the hea had nonfarm employment may differ less than the average figures ind cated. Property income, the chief cause of the difference in average i come, was received by only a few families in each category.

Adjustment Potential

The need to increase income is not considered to be critical fo any of the families in this group. There is little doubt, however, tha farm income could be considerably increased by some of the farm fam lies. The data indicated that there is some underutilization of both lan and labor by families in all three farm subgroups. However, since thes families do not have an "income problem" as defined in this repor specific farming adjustments will not be considered.

In this group, the adjustment problem of family members other tha heads and wives is also relatively minor. From the 134 families i Group 1, there were, other than family heads, only 21 males over 1 who were not in school or employed at a wage of $2,000 or more (Tabl 7). This is an average of one such person in 6.4 families. More than hal of these had 9 or more years of school (with most having completed hig school). Only one of them had less than 5 years of school.

TABLE 7.—Characteristics of Family Members Over 14 Years of Age, Other Tha Head and Wife, Rural Families Obviously Without A Major Income Problem[1]

Item	Males		Females	
	White	Negro	White	Negr
	Number			
Under 30 years of age:				
Employed at $2,000 or more	3	..	..	..
Employed at less than $2,000[2]	..	..	1	..
In school	26	1	19	4
Not in school				
Under 5 years schooling	..		..	..
5-8 years schooling	6	.	1	..
9 or more years schooling	10	2	-	..
30-44 years of age:				
Not employed[3]				
Under 5 years schooling	1	..	..	
5-8 years schooling	1	..	..	..
45-59 years of age:				
Employed at $2,000 or more	2	..	..	..
Not employed[3]				
5-8 years schooling	1	..	1	..
9 or more years schooling	..	..	1	..
60 years or older or disabled	..	..	7	..
Total	50	3	37	4

---

[1] See pages 6-7 for definition.
[2] Full-time.
[3] Full-time or at $2,000 or more.

In these 134 families there were, other than family heads or wives of family heads, only 11 females over 14 who were not in school and not employed at $2,000 or more. This was one in every 12 families. Eight of these had completed 9 or more years of school, and most had completed high school.

Of those members over 14 in school, both male and female, almost all showed normal progress toward completion of high school.

Family Members Who Had Left Home

More than three-fourths of the family members who had left the families in Group I since 1945 had completed 9 or more years of school (Table 8). None had completed less than 5 years of school. Almost two-thirds of these persons had remained within the area. About one-third of those who were no longer in the area had gone to Texas. Only about 10 percent of the males were in the laborer occupational classes. Only one-sixth of the females were employed.

TABLE 8.—Distribution of Family Members Who Had Left Home Since 1945 With Respect to Occupation and Location, Rural Families Obviously Without a Major Income Problem[1]

Item	Males		Females	
	5-8 years school	9 or more years school	5-8 years school	9 or more years school
Occupation:				
Professional	. .	3	. .	2
Clerical	. .	2	. .	3
Sales	1	2	. .	1
Craftsman	4	. .	. .	. .
Operative	3	4	. .	. .
Service work	. .	. .	1	1
Laborer, nonfarm	1	2	. .	. .
Farm laborer	. .	1	. .	. .
Student	. .	1	. .	. .
Military service	1	3	. .	. .
Unknown	1	. .	. .	. .
Wife	. .	. .	5	34
Total	11	18	6	41
Location:				
Local area	3	12	4	29
New Orleans	. .	. .	1	1
Baton Rouge	3	. .	. .	1
Lake Charles	. .	. .	1	1
Alexandria	. .	1	. .	1
Elsewhere in Louisiana	. .	. .	. .	3
Texas	3	2	. .	4
Other state	1	. .	. .	1
Military service	1	3	. .	. .
Total	11	18	6	41

---

[1] See pages 6-7 for definition.

Families With Obviously Limited Adjustment Potentia

Families with obviously limited adjustment potential (Group 1 families) accounted for about one-fourth of all families in the sampl The 145 families in the group have been further divided into thre subgroups, primarily to facilitate discussion of resource control an use: (1) families whose chief income source is from property; (2) nonfarr families whose chief income consists of transfer payments; and (3) farr families, by census definition, whose chief income consists of transfe payments. Each of the subgroups is separately discussed in this sectior followed by discussion of the group as a whole.

All male heads of the families whose major source of income wa transfer payments were over 64 or had a physical disability. All mal heads of the families primarily dependent on property income wer over 44 years of age; about two-thirds were over 60.

It appears that part-time and residential farming in connection wit the receipt of transfer payments is largely a stage in the transition be tween farm and nonfarm activity. About three-fourths of the mal heads of *nonfarm families* in this group were retired farmers. Most o the others had been farm laborers, sawmill workers, or unskilled worker at other nonfarm jobs. About three-fourths of the male household head

TABLE 9.—Land Availability and Use, Rural Families With Obviously Limited Adjustment Potential[1]

Item	Unit	Major income source: transfer payments		Major source of income from farm propert
		Nonfarm families	Farm families	
Number of families		75	41	29
		....	Average	....
Land owned	Acres	7.7	27.4	59.6
Land rented in	Acres	..	5.2	2.5
Land rented out	Acres	6.8	3.9	18.7
Land operated	Acres	..	28.7	43.4
Open land	Acres	..	21.6	29.1
Crops	Acres	..	6.0	6.1
Cash Crops	Acres	..	3.6	3.0
Idle cropland and pasture	Acres	..	15.6	23.0
Unutilized open land	Acres	..	9.3	1.8
Rent:				
Per acre of open land rented in	Dollars	..	23.25	6.32
Per acre of open land rented out	Dollars	7.06	22.04	28.55
Value of farm produce per acre of open land operated	Dollars	..	39.00	38.00
Farm income per acre of open land operated	Dollars	..	7.36	1.11
Farm earnings per acre of open land operated	Dollars	..	21.90	16.81

[1] See page 6 for definition.

of farm families had been full-time farmers for most of their lives; the others had been part-time farmers or nonfarm workers.

Ownership of farm property and the amount of family labor available apparently are the major factors that determine whether any farming operations continue after the family head starts to receive transfer payments. More than three-fourths of the transfer payment recipients who were classed as farm operators owned farm property as compared with only a fifth of those who were classed as nonfarm. Farm households had an average of more than twice as much available male labor as nonfarm households. The size of the family labor force also tended to determine the extent of farming operations by families within the farm subgroup. Farms that could be classed as part-time or commercial, by census definition, had an available male labor force about three times as large as those that were census residential farms.

TABLE 10.—Labor Availability and Use, Rural Families With Obviously Limited Adjustment Potential[1]

Item	Major income source: transfer payments		Major source of income: farm property
	Nonfarm families	Farm families	
Number of families	75	41	29
		Average hours	
Male heads:			
Available	527	862	1,219
Nonfarm work	80	...	21
Farm wage work	47	8	....
Female heads and wives:			
Available	1,511	1,497	1,757
Nonfarm work	32	...	29
Farm wage work	20	15	....
Other males over 14:			
Available	202	1,081	753
Nonfarm work	72	204	263
Farm wage work	57	28	....
Other females over 14:			
Available	374	698	566
Nonfarm work	73	104	201
Farm wage work	20	20	....
Children 10-13:			
Available	100	132	29
Hours remaining:			
Male heads	400	854	1,198
Female heads and wives	1,459	1,482	1,728
Other males	73	849	490
Other females	281	574	365
Children 10-13	100	132	29
Total hours used for farm work	....	832	896

[1] See page 6 for definition.

Nonfarm Families With Heads Receiving Transfer Payments

Among the nonfarm families with obviously limited adjustment po tential, 75 depended primarily on transfer payments for their income These families accounted for 13 percent of all households surveye They owned about 2 percent of all land owned by sample families. Mor than half of this land, however, was owned by only two families. Most o the land owned was rented out, at an average rental of $7.00 per acre o open land (Table 9).

Labor Use: Male heads in this group averaged about 18 days of non farm work during the year at an average wage of $2.71 per day, an about 10 days of farm wage work at an average of $1.68 per day (Tabl 10). This work was done by a few individuals and generally consiste of caretaker chores, yard work, and similar activities.

The small amount of nonfarm work done by female heads an wives consisted entirely of domestic work at a low wage.

Farm Families With Heads Receiving Transfer Payments

The 41 farm families in Group II whose income consisted chiefl of transfer payments constituted about 7 percent of the sample. The owned slightly more than 4 percent of the farm land in the sample an operated slightly less than 4 percent. The amount of land owned an operated was typically small. Only one family had more than 100 acres Two families in the group had farm incomes of more than $1,000.

Land Use: About 60 percent of these farms were residential units b census definition. Little use was made of the land operated except fo that used on some farms for one or two cows. On the average more tha two-fifths of the open land operated was unused (Table 9). The leve of utilization of the remaining land was low. The total value of agricul tural produce, including the value of farm privileges, was only $39 pe acre of open land operated.

Labor Use: Neither male family heads nor female heads and wive did any nonfarm work. They performed a very small amount of farm wage work (Table 10). Although the presence of other family member appeared to affect the extent of farming operations, indications ar that their labor was not fully utilized in farming. On those farms—almos half—on which there were no such family members the average amoun of family farm labor used was about 470 hours. On farms where the were present, the average amount of family labor used was about 1,16 hours. Thus it appears that these family members contributed an average of about 700 hours of labor on those farms where they were present

Capital: Net worth of these families averaged about $7,000. The estimated value of farm assets used was $7,700, of which $750 was in livestock and machinery.

Families With Primary Source of Income From Property

Twenty-nine of the families in Group II were primarily dependent on property income of less than $2,000 per year. They make up about 5 percent of the families in the sample. They owned slightly more than 6 percent of the land and operated slightly more than 3 percent. These were largely families with elderly male heads or female heads. However, the average age of family heads was slightly lower than for families receiving transfer payments. The average amount of farm land owned was larger than for families receiving transfer payments, although only about one-tenth of the families owned more than 100 acres. Only 2 of the 29 families in the group were Negro.

Land Use: Only about 6 percent of the open land on these farms was unused, but the return to open land operated was low (Table 9). A much larger proportion of land was used for livestock than on those farms where the family received transfer payments. Less than half the families in the group sold farm produce valued at $250 or more. Farm income and farm earnings per acre of land operated were low.

Labor Use: Two of the male heads did a small amount of nonfarm work, one as a carpenter and one as a blacksmith.

One wife worked part-time on the parish bookmobile.

The amount of farm labor furnished by family members, other than family heads and wives, over 14 years of age averaged about the same as for families receiving transfer payments. In families where there were no such members the average amount of family labor used for farming was almost 500 hours; in families where there were such members an average of 1,225 hours of family farm labor was used. Thus other family members contributed almost 800 hours of farm labor on farms where they were present.

Capital: The average net worth of these families was slightly more than $19,000. The average value of farm assets used was about $14,500, of which slightly more than $2,000 was in livestock and machinery.

Family Income

Average family incomes of the three subgroups of families considered to have limited adjustment potential are shown in Table 11. The major income differences, aside from differences in source, resulted from differences in incomes of family members other than family heads and wives, and the differences in value of farm privileges in the two farm subgroups. Differences in incomes of other family members are regarded as chance differences. Even when the nonfarm employment income of these other members is included, however, the per capita income received by the three subgroups is fairly similar.

Adjustment Potential

Male Heads: It may be assumed that all of the male heads in this group have practically no nonfarm employment potential. Most are

TABLE 11.—Income of Rural Families With Obviously Limited Adjustment Potentia

Income source	Major income source: transfer payments		Major source
	Nonfarm families	Farm families	income: farm property
Number of families	75	41	29
	. . . .	Dollars per family	. . . .
Welfare payments	760	736	53
Other transfer payments	342	345	8
Property rental, leases, and royalties	44	135	950
Work of male heads	37	7	19
Work of female heads and wives	14	7	21
Farm income	. . . .	159	32
Value of home produced food	72	314	457
Total	1,269	1,703	1,540
Work of other family members	159	435	648
Total family earnings	1,428	2,138	2,188
	. . . .	Dollars per capita	. . . .
Per capita family earnings	525	622	783

[1] See page 6 for definition.

over 65 years old or have some physical disability. The general level o education is extremely low. Most have already made any income-generat ing adjustments that they will make in the form of obtaining transfe payments or renting and leasing land. And in comparison with the groups from which most of these families came (families on small, low-income farms) their general level of income is high, particularly on a per capita basis. In fact, from the standpoint of income most members o this group are better off than they ever were during their working lives.

From the amount of unused and underutilized land and the amount of family labor that was not used, it is obvious that some farm families in this group could increase farm income. It is not to be expected that many of these families would be interested in intensifying their farm enterprise, but some families, especially in the group receiving property income, already have a considerable investment in livestock, and others could easily increase livestock production. In general, these families, as well as most others in the sample realized low returns from livestock production in relation to the amount invested. However, the general direction of adjustment of most of Group II families presently classed as farm families will be toward the nonfarm category. This will occur as additional family members leave home.

Wives and Female Heads: Few of the wives or female heads of families are likely to do much to increase income. Although about a fifth are under 50 years of age, most of them family heads without husbands, only three had more than 8 years of schooling. About half had less than 4 years. Unless the level of economic activity in the area should increase drastically, they are not likely to find nonfarm employment. All of them lack sufficient land or family labor to attain significant increases in income through farming.

Other Family Members: In 145 families in Group II there were, other than family heads, 29 able-bodied males and 21 females over 14 and under 60 years of age, not in school, and not employed at $2,000 or more (Table 12). This was one male for every five families in the group. One-sixth of these males were under 30 years of age and had 9 or more years of schooling, about half were under 30 and had 5 to 8 years of schooling. These persons should be able to make a transition to nonfarm employment, perhaps with some assistance in locating such employment and in training for it. About one-fourth of these persons appear to be in a low employability status because of age or education, or both.

There was one female in this category for each 6.9 families in the group. Of these, 38 percent were under 30 years of age and had 9 or more years of school. A like percentage were under 30 and had 5 to 8 years of school. Less than one-fourth of these persons could be considered unemployable because of age or education, or both. However, it is likely that most who leave home will do so through marriage and probably will not do much nonfarm work.

TABLE 12.—Family Members Over 14 Years of Age, Other than Head or Wife, Rural Families With Obviously Limited Adjustment Potential[1]

Item	Male		Female	
	White	Negro	White	Negro
	Number			
Under 30 years of age:				
Employed at $2,000 or more	3	. .	3	. .
Employed at less than $2,000[2]	. .	3	. .	1
In school	8	9	9	15
Not in school—not employed				
Under 5 years schooling	. .	1	. .	1
5-8 years schooling	3	9	2	6
9 or more years schooling	2	2	3	4
30-45 years of age:				
Employed at $2,000 or more	1	. .	2	. .
Employed at less than $2,000[2]	1	. .	1	. .
Not employed[2]				
Under 5 years of schooling	. .	3	1	. .
5-8 years schooling	1	. .	. .	. .
9 or more years schooling	1	. .	. .	. .
45-60 years of age:				
Not employed[3]				
Under 5 years schooling	. .	1	. .	. .
5-8 years schooling	1	. .	2	. .
9 or more years schooling	1	. .	. .	. .
60 years or older or disabled	6	1	4[4]	2
Total	28	29	27	29

[1] See page 6 for definition.
[2] Full-time.
[3] Full-time or at $2,000 or more.
[4] One school teacher included.

Family Members Who Had Left Home

Approximately half of the family members who had left home fron this group since 1945 had completed more than 9 years of school (Tabl 13). About 8 percent had completed less than 5 years of school. Three eighths of the males were in the laborer and farm occupational groups four-fifths of these had completed less than 9 years of school. Less tha one-fifth of the females who had left home were employed. Of those four fifths had completed 9 or more years of school.

Slightly more than half the persons who had left home were n longer in the area. About two-fifths of those not in military service wh had left the area had left Louisiana. New Orleans was the favored poin of migration in Louisiana.

TABLE 13.—Distribution of Family Members Who Had Left Home Since 1945 Wit Respect to Occupation and Location, Rural Families With Obviously Limited Adjustment Potential[1]

Item	Males			Females		
	Under 5 years school	5-8 years school	9 or more years school	Under 5 years school	5-8 years school	9 or more years school
Occupation:						
Professional	..	..	6	..	..	3
Proprietor	..	..	3	..	..	..
Clerical	..	..	4	..	..	2
Sales	..	1	1	..	1	1
Craftsman	1	2	3	..	..	..
Operative	..	2	5	..	1	.
Service work	..	1	2	..	..	1
Laborer, nonfarm	3	10	3	..		
Farm laborer	..	1	..	..	.	.
Farmer	3	3	2	..	..	...
Military service	..	2	5	..	..	..
Unknown or unemployed	1	1	1	..	..	1
Wife	..	..	..	2	24	20
Total	8	23	35	2	26	28
Location:						
Local area	4	10	10	2	18	12
New Orleans	..	3	5	..	1	4
Baton Rouge	1	1	1	..	1	3
Lake Charles	1	..	5	..	2	..
Alexandria	..	..	..	..	..	2
Elsewhere in Louisiana	..	1	3	..	..	..
Texas	2	4	3	..	1	3
Other state	..	2	3	..	3	4
Military service	..	2	5	..	..	..
Total	8	23	35	2	26	28

[1] See page 6 for definition.

Farm Families Primarily Dependent on Farming

About 43 percent of the sample families were classified as Group III families—farm families primarily dependent on farming that were neither obviously without an income problem nor obviously of limited adjustment potential. In order to examine more closely the personal and farm characteristics of these 248 families they were separated into subgroups. They were first divided according to size of farm operated, then each of the three size categories was divided into nonowner and owner families, and these were further broken down according to whether or not the family heads or their wives received incomes from nonfarm employment.

Because of their numerical importance the families operating the smallest farms are discussed separately from the families operating farms in the two larger size categories. Some parts of the discussion relating to families on farms in the two larger size groups are combined because of the smaller numbers of families involved.

Farm Families Operating Small Farms

About 70 percent of the Group III families were on farms definitely too small to earn $2,000 farm income on a sustained basis. These 177 families constituted the hard core of low-income farm families in Group III. The family heads were all primarily farmers, but they operated less than 50 acres of open land and less than 30 acres of cropland. Six of the families actually received more than $2,000 farm income in the survey year mainly as a result of extremely high yields, and in any given year it is to be expected that a very small proportion of these families will receive an unusually high farm income. However, this does not disturb the major premise that these farms are not capable of sustaining such a level of income.

Incomes of the four subgroups of small farm families are shown in Table 14. Except for the owner families with heads having nonfarm employment, farm incomes to these subgroups were very similar. The major differences in family incomes resulted from the nonfarm employment income of the operators. Owner families had small incomes from property and nonowner families had slightly higher transfer payment incomes. Even with nonfarm employment income, family money income (excluding the value of farm privileges) did not reach $2,000 for any subgroup. Per capita family earnings were low for all subgroups, but especially so for the large number on nonowner families in which the head did not have nonfarm employment.

Nonowner Families In Which the Heads Received Less Than $250 from Nonfarm Employment

About 18 percent of the families in the sample were nonowner families in Group III whose heads received less than $250 from nonfarm employment. These 101 families operated about 9 percent of the farm land

TABLE 14.—Income of Group III Families Operating Farms Definitely Too Sma to Sustain $2,000 Farm Income

Income source	Less than $250 nonfarm employment income to family head		$250 or more nonfarm employment income to family head	
	Nonowners	Owners	Nonowners	Owne
Number of families	101	38	17	21
	Dollars per family			
Farm income	836	830	866	689
Work of male heads	27	15	600	913
Work of wives	16	31	49	5
Transfer payments	72	32	52	14
Other nonwork income	4	87	10	105
Value of farm produced food	426	475	393	567
Total	1,381	1,470	1,970	2,293
Work of other family members	95	241	8	106
Total family earnings	1,476	1,711	1,978	2,399
	Dollars per capita			
Per capita family earnings	268	372	412	436

in the sample. The average rental for land rented in was almost $25 per acre of open land (Table 15).

Land Use: Less than half the open land operated by these families was in cash crops and about one-eighth was not used for either crops or livestock. However, the gross value of product per acre of open land was high as compared with most other groups. Farm income per acre of open land, at about $32, also was relatively high.

Labor Use: About 10 percent of the male heads had nonfarm employment for a few days during the year at an average wage of about $6 per day. Most of them worked at agricultural processing plants, such as rice driers, sugar mills, potato kilns, and canning plants. A few were employed on road work or at local construction work (Table 16).

Three wives had some nonfarm work, two as household help and one in a canning plant.

Family labor used during the year on all farms in this subgroup averaged 1,900 hours. Other than family heads and wives, there were family members over 14 years of age on about half of these farms. Family labor used on farms without other family members averaged about 1,790 hours; on farms where there were other family members it averaged about 2,025 hours. Thus, either these family members performed very little farm labor or the labor of family heads and wives was reduced on the farms where they were present. For whatever reason, available labor was considerably underused on these farms.

Capital: The average net worth of these nonowner families was about $550. The value of farm assets used averaged almost $7,900, of which about $900 was in machinery and livestock.

TABLE 15.—Land Availability and Use, Group III Families Operating Farms Definitely Too Small to Sustain $2,000 Farm Income

Item	Unit	Less than $250 nonfarm employment income to family head		$250 or more nonfarm employment income to family head	
		Nonowners	Owners	Nonowners	Owners
Number of families:		101	38	17	21
		Average			
Land owned	Acres	....	27.8	....	26.5
Land rented in	Acres	27.8	3.4	29.3	3.0
Land rented out	Acres	....	.1	....	.9
Land operated	Acres	27.8	31.1	29.3	28.6
Open land	Acres	26.7	27.8	27.9	23.6
Crops	Acres	19.2	16.9	17.8	12.6
Cash crops	Acres	12.2	10.4	10.5	8.0
Idle cropland and pasture	Acres	7.5	10.9	10.1	11.0
Unutilized open land	Acres	3.7	1.3	1.3	3.8
Rent per acre of open land rented in	Dollars	24.70	21.08	26.29	19.38
Rent per acre of open land rented out	Dollars	....	15.00	....	68.80
Farm produce value per acre of open land operated	Dollars	91.00	79.00	95.00	87.00
Farm income per acre of open land operated	Dollars	31.31	29.86	31.04	29.19
Farm earnings per acre of open land operated	Dollars	47.27	46.94	45.12	53.22

TABLE 16.—Labor Availability and Use, Group III Families Operating Farms Definitely Too Small to Sustain $2,000 Farm Income

Item	Less than $250 nonfarm employment income to family head		$250 or more nonfarm employment income to family head	
	Nonowners	Owners	Nonowners	Owner
Number of families	101	38	17	21
	.... Average hours		....	
Male heads:				
Available	2,059	1,751	2,080	2,080
Nonfarm work	20	12	459	652
Farm wage work	24	8	14	57
Wives and female heads:				
Available	1,998	1,832	2,080	2,080
Nonfarm work	38	50	120	....
Farm wage work	9	9	14	10
Other males over 14:				
Available	634	744	281	485
Nonfarm work	72	109	....	88
Farm wage work	7	57	9	13
Other females over 14:				
Available	669	602	404	317
Nonfarm work	45	79	....	....
Farm wage work	9	19	9	110
Children 10-13:				
Available	313	208	73	317
Farm wage work	....	4	....	11
Hours remaining:				
Male heads	2,015	1,731	1,607	1,371
Wives and female heads	1,951	1,773	1,946	2,070
Other males	555	578	272	384
Other females	615	504	393	207
Children 10-13	313	204	73	306
Total hours used for farm work	1,902	1,575	1,828	1,343

Adjustment Potential: The nonfarm employment potential of the family heads in this subgroup was extremely low. Almost half were over 45 years of age and about four-fifths had less than 5 years of schooling. Only 17 percent were under 45 and had more than 4 years of schooling; about 3 percent were under 45 and had more than 8 years of schooling.

About two-fifths of the operators under 45, one-half of those from 45 to 54, and two-thirds of those over 54 stated that they would not accept nonfarm employment under any conditions.

Fifty-two percent of the operators under 35 years of age, 23 percent of those from 35 to 44, 18 percent of those from 45 to 54, and 5 percent of those over 54 thought they could find nonfarm employment if they wanted to. The average wage at which they thought they could find nonfarm employment was $2,600 per year for those under 35 and about $2,100 per year for each of the three groups over 35. Some of these operators were among those who stated that they would not accept nonfarm employment. The others indicated that the wage they could get was lower than they would accept.

The average wage quoted as that at which nonfarm employment would be accepted if it meant moving off the farm was $3,200 per year for operators under 35, $3,000 for those 35 to 44, and $2,300 for those in the two older age groups.

On the basis of age, education, stated attitude toward nonfarm work, and awareness of nonfarm opportunities in relation to acceptable nonfarm wages, it is estimated that about one-third of those under 35, one-fourth of those 35 to 44, and one-twelfth of those over 45 possibly may move into nonfarm employment. This would reduce by about one-fifth the number of operators in this low-income farm group. These estimates assume no large change in the general level of economic activity and growth. A large expansion of industrial activity in the area might draw upon some individuals who otherwise are not highly employable. A decline in economic activity would retard movement toward nonfarm employment. The estimates also assume no large scale or intensive assistance in job location or placement.

About 3 percent of this subgroup had moved out of full-time farming between the end of 1956 and mid-1957.

One-fifth of the heads of these nonowner families were above 54 years of age in 1956, and will, therefore, be eligible for old age welfare assistance by 1965. All are likely to move into this program. It will be recalled from the discussion of the welfare recipient group that there is a strong tendency for renters and share croppers to move to the nonfarm status when they become eligible for welfare assistance. At the least they will move into the part-time and residential category.

By 1965, then, the number of sample families in this subgroup could be reduced some 40 percent by losses to nonfarm employment plus retirements. The net reduction in number of families of this type within the area will depend upon the number of young persons who enter farming at this level. In the sample, entry of operators under 35 years of age into this category appears to have been at the rate of about 2 percent per year. This rate would just about offset reductions due to nonfarm employment. Whether this rate of entry is maintained in the area will depend on whether the number of young people obtaining nonfarm employment increases.

According to the above estimates, at least 60 percent of the *existing* families in this subgroup will still be farming in 1965. What can be expected in the way of farm adjustments to increase their incomes?

These people face many obstacles to farming adjustments. The most obvious is the small size of their farms. If a net return of $100 per acre were realized on every acre in crops, these families still would average a net income of less than $2,000 per year. Before farm income can be increased appreciably some way must be found to increase the size of farm. At the present rate or return to land on these farms, average farm size would have to be more than doubled in order to yield a $2,000 i come. However, landholdings in the area, with the exception of a fe plantations, are small. Consequently, the usual parcel of land availabl for rent or purchase is small. Only about one-fourth of the operato thought it would be possible to obtain additional acreage close enoug to their present farms to make operation of the additional land profi able.

A second obstacle to farming adjustments is capital limitation. I farm size were increased, new investments of several thousand dollar per farm would be required for mechanization alone. Yet these operator have little or no borrowing capacity. About three-fourths had a ne worth at the time of the survey of less than $1,000, not including household goods; more than a third had a negative net worth. Only 6 percen had a net worth of as much as $2,000.

A third major obstacle to farming adjustments by these families i limited production alternatives, partly associated with current program and with lack of markets. The farms are too small to sustain most commercial livestock enterprises and many of them would be too small eve if their size were doubled. Cotton, sugarcane, and rice are the major cash crop alternatives in the area (all three are not suitable for all parts o the area). Generally, these small farms are limited to a small allotment of one of these crops. Cotton allotments are generally 5 to 10 acres. Corn is produced as feed for workstock and for livestock produced for home use, but there is little market for any small surplus that might exist. Sweetpotatoes are a possible alternative or supplementary cash crop, but as produced on these farms the degree of success in their production is highly variable. Also, prices for sweetpotatoes fluctuate widely from year to year, depending upon production. Therefore, farm income is tied almost directly to the acreage of allotment crops and the yield obtained from them. An increase in total farm size without an increase in allotments of major cash crops would not result in a corresponding increase in farm income unless profitable cash alternatives could be found.

A fourth, and by no means the least, obstacle to farming adjustments is the lack of awareness and motivation. The majority of operators apparently either do not recognize any problem or have become resigned to their present status. In answer to a question concerning present farm size only one-eighth indicated that they thought their farms were too small. When asked if they would like to make any change that they thought might increase farm income, two-thirds answered "no." Of those who did express a desire for some change almost half mentioned more allotments, about a fourth wanted to move up in tenure status, about a fourth said they would like to buy tractors and a very small proportion expressed the desire to operate larger farms or make some change in their present farms.

The use of credit by most of these operators is limited to borrowing a few hundred dollars annually for living expenses, fertilizer, and seed. More than half of those who used credit borrowed from their landlords or other individuals, a fifth borrowed from merchants or ginners, and a fourth from lending agencies. About three-fourths indicated that they received all the credit they could use. Of those who indicated a desire for more credit, two-fifths said they could not obtain more, and three-fifths gave an answer involving risk or aversion to debt as the reason for not using more.

An examination of the individual schedules indicated that a negligible proportion of the operators are "on the way up" in farming. There appears to be little likelihood of much volitional adjustment to increase incomes within this subgroup. Since some of the operators change farms frequently (although one-fifth had been on the same farm for 15 years or more) some of them can be expected eventually to move to larger farms as a matter of chance. However, as indicated above, this would not automatically assure a larger farm income. Eventually, also, some families undoubtedly will become owners, but they are likely to become owners of small farms. Major changes in farm incomes can be expected to result only from external influences.

Owner Families In Which the Heads Received Less than $250 from Nonfarm Employment

The heads of 38 families in Group III, constituting almost 7 percent of the families surveyed; were owners of small farms who had earned less than $250 in nonfarm employment during the year. They owned about 4 percent of the land and operated the same percentage.

Land Use: These families had an average of about 10 acres in cash crops, which was slightly more than one-third of the open land operated. There was little unused land, but a large proportion of the land was underutilized, as indicated by the large percentage of idle cropland and pasture and the low gross value of product per acre as compared with farms of comparable renter families. Farm income per acre was about in line with that of the renter families, although renters paid out more than a fourth of the gross product to landlords.

Labor Use: Three of the male heads of these families had a small amount of nonfarm employment, two at road work and one at a potato kiln.

One wife worked at a school lunch room during the school year, one worked for a short period in a canning plant, and one did a few days of household work.

Less farm labor was performed by these families than by comparable renter families, partly because of smaller acreages in cash crops, partly because of greater use of machinery, and partly because more labor was hired.

The average amount of family farm labor used was 1,575 hours. Slightly more than half of the families had members over 14 other than the heads and their wives. On these farms, an average of about 40 hours more family farm labor was used than on the farms not havin other family members over 14.

Capital: The net worth of the families averaged slightly more tha $9,000. Assets used were valued at almost $11,000, of which $1,600 wa in livestock and machinery.

Adjustment Potential: The prospects for movement of these famil heads into nonfarm employment are poorer than for comparable non owners. Less than a third of the male heads were under 45 years of age at the time of the survey less than a sixth were under 45 and had completed more than four years of school. On the basis of the factors use to evaluate nonfarm employment prospects of nonowner heads, it i estimated that no more than 10 to 15 percent of these operators wil ever move into nonfarm employment. One of the operators had becom a full-time country store keeper between the end of 1956 and mid-1957 but planned to maintain farming operations. This type of activity, schoo bus driving, and similar local employment is most likely to draw upo heads in this group.

Approximately a third of these existing families are likely to b retired from full-time farming by 1965. They will either become welfar payment recipients, live on property rentals, or receive income from both these sources.

What are the prospects of these families for increasing farm income

In general, these owner operators face the same size and production alternative limitations as the comparable nonowner group. About one-fifth thought it would be possible to buy or rent additional land in the vicinity of their present farm.

With respect to capital, most of these operators were in a much better position than their nonowner counterparts. More than one-third had a net worth of more than $10,000. These operators could finance almost any of the improvements that would be required in connection with an increase in farm size if they were willing to use their borrowing capacity. About half of these, however, were nearing retirement. About two-fifths had net worths of $5,000 to $10,000. These also could finance a considerable amount of expansion and improvement in farming. The remainder, about one-fourth, had net worths of less than $5,000, with about half of these less than $2,000. In terms of borrowing capacity, they were little better off than the mass of the renter group.

In terms of attitudes and awareness, the families in this group appeared to be similar to those in the renter group. Only about a third expressed the opinion that their farms were too small. Less than a third indicated that they could think of any change that might increase farm income. More than half the affirmative answers to this question involved the planting of more allotment crops. The remaining answers involved increasing farm size or changing enterprises, or both.

Two-thirds of these families had used credit the previous year, mostly for living expenses, fertilizer, and seed. Almost half of those who borrowed used lending agencies. The remainder were about evenly split between those who borrowed from individuals and those who borrowed from merchants or dealers. About a third of the operators felt that they could make profitable use of more credit, but of these about one-half thought they could not get more credit and the others expressed a distaste for debt or fear of inability to repay.

Nonowner Families in Which the Heads Received More than $250 from Nonfarm Employment

Seventeen nonowner families in Group III, or about one-seventh of those on farms in the smallest size category, received more than $250 from nonfarm employment of the family head in the survey year. These families accounted for about 3 percent of the sample. They operated less than 2 percent of the farm land operated by sample families.

Land Use: Land use by these families was similar to the use by the other families in the same farm-size category (Table 15). A slightly smaller proportion of the open land they operated was used for crops and cash crops and a larger proportion for livestock than was used for these purposes by the nonowner families with less nonfarm employment. Gross production per acre of open land was high compared with that on other small farms in Group III. Net returns to land did not differ greatly from those of the other groups. As with the other families on small farms, the amount of land actually unused was small, but a considerable portion of the land operated was not used intensively.

Labor Use: All the male family heads had part-time nonfarm employment, averaging 57 days for the survey year. The average wage received was $10.34 per day. About two-thirds of these operators were employed in jobs allied with farming—working in cotton gins, potato kilns, sugar mills, or rice driers, or measuring cotton acreage. The others worked on construction jobs, in service stations, and at various other jobs.

Two wives had part-time nonfarm employment at low wage rates, one in a pressing shop and the other as a household worker.

The average amount of family farm labor used during the year on these farms was 1,828 hours. Only four families had members over 14 years of age other than the heads or their wives. On these four farms, the average amount of family farm labor used was about 1,000 hours more than on those farms not having such family members.

Capital: The average net worth of these families was $1,420. The value of assets used averaged about $11,500, of which almost $2,000 was in livestock and machinery.

Adjustment Potential: As a group, family heads on these farms are younger and have a higher level of education than those on comparable farms who did little nonfarm work. All were under 45 years of age, and about two-thirds were under 35. Almost two-thirds had completed

5 or more years of school and almost one-third had completed 9 or more years.

About three-fifths of these operators said they could obtain full-time nonfarm work if they wanted to. The average wage mentioned was about $2,000 per year. More than half said they would accept nonfarm employment even if it meant moving off the farm. The average wage at which they would move was $3,250 per year. It is estimated that one-third to one-half of these operators eventually will move into full-time nonfarm employment.

These families face the same physical obstacles to farming adjustments as do those whose heads had no nonfarm employment, but they have a slightly better capital position. Almost half reported a net worth of more than $1,000 and more than one-fourth reported a net worth of more than $2,000. Almost one-third owned tractors and allied equipment.

Despite the advantage in age and education and the small advantage in net worth these operators have, the combinations of answers to attitudinal questions were very similar to those of the group without nonfarm employment. About a third indicated that they thought their farms were too small, but only a fifth expressed a desire to make any farming changes. These changes included increases in cotton acreage, ownership of machinery, and farm ownership. The use of credit was low and aversion to borrowing was high. The general level of awareness of opportunities for increasing farm income was low. Therefore, while some of these operators who stay in farming may make slightly more progress than those in the comparable group without nonfarm employment, internal farming adjustments are likely to be limited.

Owner Families in Which the Heads Received More than $250 from Nonfarm Employment

The heads of 21 of the Group III owner families on small farms received more than $250 from nonfarm employment. These families accounted for almost 4 percent of the families in the sample. They owned slightly more than 4 percent, and operated slightly less than 4 percent, of the land owned and operated by sample families. They represented more than a third of the farm owner families in the small-farm category. The average level of intensity of farming operations was slightly lower than that of the other subgroups in this size category. Compared with the comparable nonowner group, there was more nonfarm employment and less farm income. It is possible that this was the result of greater flexibility and freedom of choice associated with ownership.

Land Use: About one-sixth of the open land on these farms was unused (Table 15). Approximately one-third was in cash crops. Returns to land were comparable to returns to land on farms in other subgroups of families on small farms.

Labor Use: All male heads of these families had nonfarm employment. They averaged about 82 days of nonfarm work during the year.

More than one-third worked as carpenters or carpenters' helpers, or at some other construction job. About one-fifth worked at logging or sawmilling jobs. One-seventh worked in agricultural processing jobs. The rest worked at miscellaneous jobs such as oil field and dredge boat work. The average wage received was approximately $11 per day.

Wives in this group did no nonfarm work.

About three-fifths of these families had no able-bodied members over 14 except the heads and wives. On these farms the average amount of family labor used was about 1,350 hours. On farms with other family members approximately the same amount of family labor was used. Thus, other family members in these families either performed little farm labor or the heads and their wives performed less labor than on the other farms. The average amount of family farm labor used by this subgroup was less than for other families on small farms because of the smaller acreage of cash crops and because tractor equipment was used on about half the farms.

Capital: The average net worth of these families was approximately $7,500. The value of assets used in farming was $8,500, of which $1,450 was in livestock and machinery.

Adjustment Potential: About three-fourths of the operators were under 45 years of age. Three-fifths were under 45 and had more than 4 years of schooling. Four of the 21 operators in this group did very little farming. It is likely that they were moving toward complete nonfarm employment. An additional one-fifth might eventually accept full-time nonfarm employment, with most remaining in part-time farming. One family head had accepted full-time nonfarm employment between the end of 1956 and mid-1957, and one was nearing retirement.

A number of operators in this subgroup appeared to have a strong attachment for farming. A few indicated that the major reason for working part-time was to help accomplish some farm objective. More than half indicated that their farms were too small. However, less than a third mentioned specific changes to increase income. These changes included shifting enterprises (to dairying, for example), increasing farm size, and buying machinery.

Only one-fifth of these families had a net worth of more than $10,000. About two-fifths had a net worth of $5,000 to $10,000, and two-fifths had less than $5,000. About half the group made use of credit, which 90 percent of them obtained from lending agencies. Slightly more than one-fourth said that they could make more use of credit but that they could not get more or were afraid of debt.

With the exception of a small number with relatively large net worths, this subgroup faces about the same obstacles to farming adjustment as other subgroups on farms in this size category. Most of them are not likely to increase farm income by very much. Some operators, however, seemed to be making progress, and it is estimated that about one-fifth of the 21 families will become fairly successful in farming by their own efforts.

Summary of Adjustment Potential of Families on Small Farms

Existing Families

Of the 177 Group III families on small farms, it is estimated that by 1965 almost one-fifth will have retired from full-time farming, either obtaining coverage under welfare programs or renting their land out, or both. Another one-fifth might move into nonfarm employment, either leaving farming or moving into the part-time category. However, the net loss of families of this type in the area is not likely to be of this magnitude. Many who accept nonfarm employment must do so at low wages and often at unstable jobs. Particularly among nonowners, there is some shifting back and forth between farming and nonfarm employment. Also, the survey showed that the recent rates of entry into the nonowner groups had been about sufficient to offset movements from these groups into nonfarm employment. The proportion of recent entries was not as high for owners as for nonowners. Among the sample families, a number of the younger owners had entered farming following World War II. The rate of entry of owners had been low since that time.

Only a very small proportion of family heads on farms at this size level are likely to make adjustments to increase income. Ten percent is a generous estimate of the number in the sample who appeared to have the combination of ability and inclination needed to move ahead in farming.

Adjustment Potential of Other Family Members On Small Farms

In the 177 Group III families on small farms there were, other than the family heads, 41 male members over 14, not in school and not employed at $2,000 or more. This is one for each 4.3 families. One-fifth were under 30 years of age and had completed 9 or more years of school (Table 17). These persons should have little difficulty in adjusting to nonfarm employment. Almost half were under 30 and had completed 5 to 8 years of school. At least a part of these would have difficulty finding nonfarm employment offering much opportunity without further training. Almost a third, who had less than 5 years of school, would almost certainly find nonfarm employment opportunities limited.

In these families there were 34 able-bodied females, other than wives or family heads, not in school and not employed at a wage of $2,000 or more. About a third of these were under 30 and had completed 9 or more years of school, a third were under 30 and had completed 5 to 8 years of school, a third had completed less than 5 years of school or were over 45 or both.

TABLE 17.—Characteristics of Family Members Over 14 Years of Age, Other than Head or Wife, Rural Families Operating Farms Definitely Too Small to Sustain $2,000 Farm Income

	Male		Female	
Item	White	Negro	White	Negro
		Number		
Under 30 years of age:				
Employed at $2,000 or more	1	..	..	1
Employed at less than $2,000[1]	1	..	1	..
In school	19	13	13	27
Not in school				
Under 5 years schooling	5	6	1	3
5-8 years schooling	5	14	1	10
9 or more years schooling	4	4	3	7
30-45 years of age:				
Not employed[2]				
Under 5 years schooling	..	1	.	2
45-60 years of age:				
Not employed[2]				
Under 5 years schooling	..	1	1	3
5-8 years schooling	..	..	2	.
60 years or older or disabled	..	2	1	4
Total	35	41	23	57

[1] Full-time.
[2] Full-time or at $2,000 or more.

Family Members Who Had Left Home From Small Farms

Less than two-fifths of the persons who had left these small-farm families had completed 9 or more years of school (Table 18); more than a fourth had completed less than 5 years. More than three-fifths were Negroes. More than half the males were in the laborer and farm occupational groups; more than four-fifths of these had completed less than 9 years of school. Less than one-eighth of the females who had left home were employed.

One-half of those who had left home were still in the area. Of those who had left the area, about one-fourth had migrated to New Orleans and almost two-fifths had left Louisiana. More than two-thirds of those who left the state went to Texas.

Farm Families Operating Medium-Size Farms

Farms are considered to be large enough to approach a $2,000 farm income, on a sustained basis, if they contain 50 to 100 acres of open land or 30 to 50 acres of cropland, or both. Ten percent of the nonowner families and 40 percent of the owner families in this subgroup had farm incomes exceeding $2,000.

Of the 248 families in Group III, 45 families operated farms of this size. Incomes of Group III families on these medium-sized farms and on large farms are shown in Table 19, by tenure status.

TABLE 18.–Distribution of Family Members Who Had Left Home Since 1945 Wi Respect to Occupation and Location, Group III Families Operating Farms Too Sma to Earn $2,000 Farm Income

Item	Males			Females		
	Under 5 years school	5-8 years school	9 or more years school	Under 5 years school	5-8 years school	9 or more years school
Occupation:						
Professional	..	..	1	..	..	1
Clerical	..	2	..	..	..	1
Sales	..	1	1	..	..	
Craftsman	..	2	1	..	..	
Operative	1	1	5	..	..	
Service	1	1	3	1	1	1
Laborer, nonfarm	5	7	4	..	..	
Farm laborer	1	1	..	..	..	
Farmer	2	5	..	..	..	
Student	..	1	1	..	..	1
Military service	1	..	..	..	..	
Unknown	..	1	..	..	..	
Wife	..	..	..	4	24	17
Total	11	22	16	5	25	21
Location:						
Local area	6	10	6	5	16	7
New Orleans	..	6	2	..	..	4
Baton Rouge	..	..	1	..	1	4
Lake Charles	2	..	..	..	1	1
Alexandria	..	..	2	..	..	..
Elsewhere in Louisiana	..	2	..	..	1	2
Texas	..	2	3	..	6	2
Other state	2	1	2	..	..	1
Military service or unknown	1	1	..	..	..	..
Total	11	22	16	5	25	21

Nonowner Families

The 30 nonowner families operating farms in this size category accounted for about 5 percent of the sample families. They operated slightly more than 4 percent of the farm land operated by all families in the sample groups.

Land Use: Only about 4 percent of the open land in these farms was considered to be unused, but less than half of the open land was in cash crops (Table 20). In terms of open land, cropland, and cash crops, these farms were about 75 percent larger than the farms of nonowner families on farms considered to be definitely too small to attain $2,000 farm income. The average cotton acreage was about 40 percent larger, and farm income was about 50 percent higher. As the difference in farm income was only slightly greater than the increase in cotton acreage, it may be inferred that the larger acreages on these farms, except

TABLE 19.—Income of Group III Families Operating Farms Large Enough to Approach or Attain $2,000 Farm Income

Income source	Medium-size farms		Large farms	
	Nonowners	Owners	Nonowners	Owners
Number of families	30	15	10	16
	. . . .	Dollars per family	. . . .	
Farm income	1,259	1,831	3,067	2,191
Work of male heads	122	35	60	12
Work of wives	3	40		30
Transfer payments	78	70	220	140
Other nonwork income	. . . .	161	90	344
Value of farm privileges	611	630	733	703
Total	2,073	2,767	4,170	3,420
Work of other family members	193	7	18	51
Total family earnings	2,266	2,774	4,188	3,471
	. . . .	Dollars per capita	. . . .	
Family earnings	380	630	974	793

insofar as they resulted in larger allotment acreages, were not effectively utilized. This is further indicated by the fact that the gross value of product per acre of open land on these farms was smaller than that on the small farms operated by nonowners.

Labor Use: Seven of the male heads in this group had part-time nonfarm employment. Three had more than $250 income from nonfarm work. Part-time work consisted of construction labor, storekeeping, logging, work at a rice drier, and work at a canning plant. The average wage received was about $6.50 per day.

No wives in the group had any nonfarm employment.

More than two-thirds of these families had family members, other than heads or wives, who were over 14 years of age. The average amount of family labor used on the farm was 2,767 hours for all farms. Those families having other family members averaged about 525 hours more of family labor use than those without other family members (Table 21).

Capital: These families averaged a net worth of $1,375. The average value of farm assets used was slightly under $15,000, of which about $1,900 was in livestock and machinery.

Adjustment Potential: The likelihood of many of these household heads moving into nonfarm employment is small. Only two-fifths were under 45 years of age. Less than one-fourth were under 45 and had completed more than 4 years of school. None had completed more than 8 years of school. Two-thirds of those under 45 either stated positively that they would not accept nonfarm employment or named wage rates much higher than they were likely to obtain. One of these heads had left farming for construction work between the end of 1956 and mid-1957, and it appeared likely that two or three more might leave.

TABLE 20.—Land Availability and Use, Group III Families Operating Farms Large Enough to Approach or Attain a $2,000 Farm Income

Item	Unit	Medium-size farms		Large farms	
		Nonowners	Owners	Nonowners	Owners
Number of families		30	15	10	16
		Average			
Land owned	Acres	....	47.2	....	94.0
Land rented in	Acres	45.8	14.9	182.4	43.9
Land rented out	Acres	....	....	2.5	10.9
Land operated	Acres	45.8	62.1	179.9	127.0
Open land	Acres	45.5	58.8	177.4	104.1
Crops	Acres	35.5	23.1	118.8	56.8
Cash crops	Acres	21.5	14.5	105.4	40.3
Idle cropland and pasture	Acres	10.0	35.7	58.6	47.3
Unutilized open land	Acres	1.8	8.1	27.8	10.1
Rent per acre of open land:					
Rented in	Dollars	21.24	7.74	28.76	25.86
Rented out	Dollars	....	....	30.00	18.06
Farm produce value per acre of open land operated	Dollars	80	75	79	94
Farm income per acre of open land operated	Dollars	27.67	31.14	17.29	21.05
Farm earnings per acre of open land operated	Dollars	41.10	41.85	21.42	27.79

TABLE 21.—Labor Availability and Use, Group III Families Operating Farms Large Enough to Approach or Attain $2,000 Farm Income

	Medium-size farms		Large farms	
	Nonowners	Owners	Nonowners	Owners
Number of families	30	15	10	16
	Average hours			
Male heads:				
Available	2,045	2,080	2,080	1,950
Nonfarm work	136	22	35	10
Farm wage work	18	19	....	....
Wives:				
Available	2,080	2,080	1,872	1,950
Nonfarm work	....	28	....	30
Farm wage work	5	14	....	....
Other males over 14:				
Available	1,262	264	465	585
Nonfarm work	142	....	....	90
Farm wage work	....	10	....	....
Other females over 14:				
Available	1,435	162	374	156
Nonfarm work	138	....	....	....
Farm wage work	1	....	32	....
Children 10-13:				
Available	402	277	250	364
Farm wage work	2	....	....	....
Hours remaining:				
Male heads	1,891	2,039	2,045	1,940
Wives	2,075	2,038	1,872	1,920
Other males	1,120	254	465	495
Other females	1,296	162	342	156
Children 10-13	400	277	250	364
Total hours used for farm work	2,767	2,340	2,585	1,207

Among the heads over 45 years of age, about one-fifth indicated that they would accept nonfarm employment, but only one had any idea as to the possibility of finding employment at anywhere near $2,500, the average wage quoted at which employment would be accepted.

One-fifth of the operators were over 55 years of age and likely to move into retirement by 1965 or before. It appears that no more than 10 to 15 percent of these family heads are likely to leave farming for nonfarm employment.

Seventeen percent of the operators in this subgroup had entered farming since 1945, seven percent of them since 1950. On the basis of these figures, it appears that, among families of this type, losses to nonfarm employment are not likely to exceed entries of new farmers.

With respect to farming adjustments to increase income, these families are in a similar position to that of comparable families on farms too small to approach a $2,000 farm income. They are on larger farms, but their average net worth is still low. Almost half had net worths of less than $1,000, one-third had net worths of $1,000 to $2,000, and only one-fifth had net worths of $2,000 to $5,000. Practically none had a capital position strong enough to finance substantial improvements. As on the small farms, the choice of production alternatives was small. Farm income was still tied very closely to cotton allotments which, although larger than on the small farms, were not large enough to result in a $2,000 farm income.

Only two of the 30 operators regarded their farms as too small. Only three indicated that it would be possible to increase farm size at their present location through renting or buying. Only three indicated that they would like to make any changes in farming: two wanted more cotton acreage and one wanted to become an owner.

Eighty-seven percent of the families used credit, usually a few hundred dollars for fertilizer, seed, and living expenses. One-fourth of those who used credit borrowed from lending agencies. One-fifth said they would like to use more credit but were afraid of getting too far in debt.

Owner Families

Fifteen of the Group III families on medium-sized farms were owners. These families accounted for slightly less than 3 percent of the families in the sample. They owned slightly less than 3 percent and operated slightly more than 3 percent of the land operated by sample families.

Land Use: It is estimated that about one-eighth of the open land in these farms was unused (Table 20). However, land use apparently was more intensive on the portion of the land used than on comparable nonowner farms, although a smaller proportion of the land was in crops and cash crops. Three of these farms were dairy or livestock farms with little land in crops. Gross product per acre of open land, at $75, was slightly lower than for nonowner families. However, farm income per acre of open land was higher.

Labor Use: There was little off-farm work by family heads or their wives. One male head was employed for a short period of time at carpentry work, and one wife was employed for about two months as a librarian.

Six of these families had family members over 14 years of age, other than heads and wives. These families used about 800 hours more family labor on the farm than did the families that did not have other members over 14. An average of 2,340 hours of family labor was used by all farms in the group.

Capital: The net worth of these families averaged about $17,000. The estimated value of farm assets used was $21,000, of which about $3,900 was in livestock and machinery.

Adjustment Potential: Four of the 15 family heads in this subgroup were under 45 years of age. None of the four had completed less than 6 years of school and two had completed 9 or more years. Only one indicated that there was any possibility of accepting nonfarm employment, and the wage he would require was high. The likelihood of any of the family heads over 45 years of age accepting nonfarm employment also seemed low. About one-fifth of the operators had entered farming since 1945.

Most of the families appeared to be making fairly efficient use of their resources, at least relative to other families in Group III. Most of them would need to increase farm size to make substantial increases in farm incomes. About one-fourth, however, had very small farming operations relative to the amount of land available. This was especially true for those approaching retirement age with no other family members present besides the head and wife.

Only one-fifth of the families had net worths of less than $10,000. All of these had net worths of more than $5,000. Thus this subgroup would not be severely limited in making adjustments by lack of capital.

Two-fifths of the operators in the subgroup indicated that their farms were too small. One-third of the operators said that it would be possible to expand farm size in their present locations by renting or buying additional land.

Only about a fourth said they could think of any changes they might make to increase income. These changes included increasing farm size, changing enterprises, and getting a larger cotton allotment.

Three-fifths of these operators had made use of credit the preceeding year. Two-thirds of those who borrowed used a lending agency. Only two of the 15 thought they could use more credit.

Farm Families Operating Large Farms

Group III farms were considered to be large enough to attain a $2,000 farm income if they had more than 100 acres of open land or 50 to 100 acres of cropland, or both. Of the Group III families on farms of this size, 70 percent of the nonowner families and 44 percent of the owner families had farm incomes exceeding $2,000. Average incomes of nonowner and owner families in this subgroup are shown in Table 19.

Nonowner Families

The 10 nonowner families who operated large farms accounted for slightly less than 2 percent of all rural families in the sample. They operated almost 6 percent of the farm land operated by families in the sample.

Land Use: These farms had an average of about 175 acres of open land, about three-fifths of which was in cash crops (Table 20). Unlike most of the small- and medium-sized farms, only one was a cotton farm. The value of gross product per acre of open land was $79. Net returns per acre of open land were somewhat lower than for other farms in Group III. About one-sixth of the open land was considered to be unutilized.

Labor Use: One male head cared for an irrigation well and canals. There was no other nonfarm employment by members of these families.

The average amount of family labor used by all families in the subgroup was 2,585 hours (Table 21). In addition to the family heads and wives, three families had other able-bodied members over 14 years of age. About 1,000 more hours of family labor was used in farming by these families than by those without such family members.

Capital: The average net worth of the families was $5,750. The estimated average value of farm assets used was about $50,000, almost $8,000 of which was in livestock and machinery.

Adjustment Potential: Half of these operators were under 45 years of age; three were under 45 and had more than eight years of schooling. None of the operators indicated a strong likelihood of leaving farming. None was in the age bracket approaching retirement. Six had entered farming since 1945, and four since 1950.

Only three of the 10 families had farm incomes of less than $2,000. Two of the three had less than $2,000 net worth. All three of the operators had less than 4 years of schooling. Two of the three had low incomes primarily because they were paying excessive rents. The third family, though on a large farm, had a small farming operation, with low yields.

Six of these families had net worths of $5,000 to $10,000, with most of this in livestock and machinery. Only three had net worths of less than $2,000. Nine had borrowed money for farm operations during the preceding year. The average amount borrowed was $3,400. Half said they needed to borrow more but either could not get more or were afraid to borrow more.

Four of the group thought their farms were too small.

Owner Families

The 16 owner families operating large farms made up slightly less than 3 percent of the sample. They owned slightly less than 6 percent of the land and operated slightly more than 6 percent of the land operated by sample families.

Land Use: About one-tenth of the open land operated by these families was unused (Table 20). The gross value of product per acre of open land was relatively high, partly because of two dairy enterprises and one large poultry enterprise. Acreage in cash crops made up less than 40 percent of the total open land operated. Average farm income and farm earnings per acre of open land were considerably less than for the families owning farms in the two smaller size categories.

Labor Use: One male head worked for a few days during the year as a carpenter. One wife worked for about two months as a bookkeeper at a cotton gin.

The 16 families averaged 1,200 hours of family labor used in farming, which was only about half the amount used by comparable nonowner families or by either owner or nonowner families on the intermediate size farms. The family labor on these farms was clearly underutilized.

There were family members over 14, other than family heads and wives, on almost half the farms. The average amount of farm family labor used on these farms was about 1,900 hours, or about 1,200 hours more than was used on farms without such family members.

Capital: The average net worth of these families was almost $26,000. The estimated average value of farm assets used was about $42,000, of which $8,300 was in livestock and machinery.

Adjustment Potential: It seems unlikely that more than 5 to 10 percent of these family heads will leave farming for nonfarm employment. Six of the operators were under 45 years of age; all of these had more than 4 years of school and half had completed more than 8 years. Four of the operators were approaching retirement age.

Of the 16 operators in the subgroup, four entered farming since 1945, and two had entered since 1950.

Despite the size of these farms, slightly less than half earned as much as $2,000 farm income. The reason for low incomes on most of these farms was that the effective farm size was not much larger than for some of the smaller farms. That is, farming operations were limited to a few acres of allotment crops and the remaining land was idle or underutilized. Low yields and excessive costs for hired labor were contributing factors on a few farms.

Farm income could be increased on most of these farms. Land is not an extremely limiting factor. Seventy percent of the families had net worths of more than $10,000. Only one-eighth had net worths of less than $5,000. On most farms, borrowing capacity had been translated, at least to some extent, into working assets. Only one crop farm did not have a tractor and allied machinery. The level of education was not extremely low, compared with that of other groups.

Summary of Adjustment Potential of Families on Medium-Size and Large Farms

Existing Families

It appears likely that no more than 10 percent of the operators of medium-size and large farms are likely to leave farming for nonfarm employment. About 20 percent are likely to leave full-time farming for retirement by 1965. About 25 percent had entered farming since 1945, a rate of entry that, if continued, would largely offset losses to retirement and nonfarm employment.

About three-fourths of the nonowner families on these farms could be considered low-income farm families, subject to the same limitations with respect to farming adjustments as the Group III families on small farms, except that they controlled a larger amount of land. About three-fifths of the owner families were in the same category, except that in addition to controlling more land they had a stronger capital position and a slightly higher educational level. In general, then, the operators of the medium-sized and large farms have enough physical resources to make some increase in farm income. Major limitations are presumed to be lack of production alternatives, motivation, and knowledge concerning production choices, enterprise combinations and farm practices.

The performance of these families reinforces the inference made regarding families on the small farms that increasing the size of their farms will not, even for families with a fairly strong capital position, insure farm incomes of as much as $2,000.

Other Family Members

On the 71 Group III farms large enough to approach or attain an income of $2,000 there were 21 able-bodied males, other than family heads, not in school and not employed at $2,000 or more (Table 22). This was one such person for each 3.4 households. From the standpoint of age, all were highly employable. From the standpoint of education, one-seventh had a very limited employment potential and one-seventh were highly employable. The remaining five-sevenths had only a fair nonfarm employment potential.

In addition to wives of family heads or children in school, there

TABLE 22.—Characteristics of Family Members Over 14 Years of Age, Other than Head or Wife, Group III Families Operating Farms Large Enough to Approach or Attain $2,000 Farm Income

Item	Males		Females	
	White	Negro	White	Negro
Under 30 years of age:				
Employed at $2,000 or more	1	..	..	..
Employed at less than $2,000[1]	1	..	..	2
In school	10	3	12	6
Not in school:				
Under 5 years schooling	1	..	..	5
5-8 years schooling	8	6	..	6
9 or more years schooling	2	1	1	3
30-44 years of age:				
Not employed				
Under 5 years schooling	..	2	..	1
45-59 years of age:				
Not employed				
Under 5 years schooling	..	..	..	1
60 years or older or disabled	1	2	3	2
Total	24	14	16	26

[1] Full-time.

were 19 able-bodied unemployed females on these farms, or one for each 3.7 households. More than a third of these had a very limited employment potential because of age, education, or both. A fifth had no major age or educational impediment. The rest were highly employable from the standpoint of age, but their employment capability was only fair in terms of education.

Family Members Who Had Left Home

Of the family members in these two subgroups who had left home since 1945, about two-fifths had completed 9 or more years of school (Table 23). Only one-tenth, all Negroes, had completed less than 5 years of school. More than half of the males who had left were in the laborer or farm occupational groups; almost nine-tenths of these had completed less than 9 years of school. Less than one-eighth of the females were employed.

More than half of the persons who had left home had remained in the area. More than a fourth of those who left the area had moved to Texas. Lake Charles was the favorite point for migration within Louisiana.

TABLE 23.—Distribution of Family Members Who Had Left Home Since 1945 With Respect to Occupation and Location, Group III Families Operating Farms Large Enough to Approach or Earn $2,000 Farm Income

	Males			Females		
Item	Under 5 years school	5-8 years school	9 or more years school	Under 5 years school	5-8 years school	9 or more years school
Occupation						
Professional	..	1	..	..	..	..
Clerical	..	..	..	..	..	3
Sales	..	..	1	..	..	..
Craftsman	..	4	..	..	..	..
Operative	..	2	2	..	..	..
Laborer, nonfarm	3	8	1	..	..	..
Farmer	2	1	1	..		
Military service	..	..	2	..	..	
Unknown	..	..	1	..	..	
Wife	..	..	..	1	10	12
Total	5	16	8	1	10	15
Location						
Local area	2	8	4	1	8	7
New Orleans	..	..	..	..	..	3
Baton Rouge	..	1	..	..	..	..
Lake Charles	..	2	2	..	..	3
Elsewhere in Louisiana	1	2	..	..	1	..
Texas	2	3	..	..	1	1
Other state	..	..	..	..	..	1
Military service	..	..	2	..	..	..
Total	5	16	8	1	10	15

Farm Laborer Families

Twenty-seven families in which the major source of income to the head was from farm wage work (Group IV families) made up almost 5 percent of the sample.

The heads of slightly more than one-fifth of these families were farm operators as well as farm laborers. They operated an average of about seven acres of land, of which about four acres were in cash crops. In general, these operators rented a few acres of land from the farmer for whom they regularly did farm work.

Labor Use: The labor of male heads in this group was about 90 percent employed at farm wage work at an average wage of slightly less than $4.00 per day (Table 24).

The available labor time of wives and female heads was about 9 percent employed at farm wage work. One wife worked part-time as a housemaid.

These families had incomes comparable to those of small farm families in which the operator did not work off the farm. Per capita family earnings were only slightly more than $300 (Table 25).

TABLE 24.—Labor Availability and Use, Rural Farm Laborer Families

Item	Labor availability and use
Number of families	27
	...... Average hours ......
Male Heads:	
Available	1,926
Nonfarm work	2
Farm wage work	1,706
Wives and female heads:	
Available	1,849
Nonfarm work	30
Farm wage work	160
Other males over 14:	
Available	963
Nonfarm work	127
Farm wage work	526
Other females over 14:	
Available	578
Nonfarm work	15
Farm wage work	56
Children 10-13:	
Available	154
Hours remaining:	
Male heads	218
Wives and female heads	1,659
Other males over 14	310
Other females over 14	507
Children 10-13	154
Total hours used for farm work[1]	162

[1] Own farm.

TABLE 25.—Income of Rural Farm Laborer Families

Income source	Income
Number of families	27
	Dollars per family
Work of male heads	848
Work of wives and female heads	72
Transfer payments	74
Farm income	67
Value of farm produced food	131
Total	1,192
Work of other family members	343
Total family earnings	1,535
	Dollars per capita
Per capita family earnings	316

Adjustment Potential

Three-fifths of the household heads in Group IV were males under 45 years of age, but only 7 percent were under 45 and had completed more than 4 years of school. Therefore, nonfarm employment opportunities for most household heads in the group were limited. The two female household heads in the group were over 50 years of age and had less than 4 years of school. The educational level of wives tended to be slightly higher than that of male heads, but was still low.

Three-fourths of the male heads under 45 indicated that they would like to find nonfarm employment. The average wage at which they said they would accept nonfarm employment was slightly under $2,500 per year. One fifth of those over 45 indicated an interest in nonfarm employment, at the same wage level as for the younger group. About one-fifth of the male heads thought that they could find nonfarm employment. The average wage that they thought they could obtain was slightly less than $2,200 per year.

Considering age, education, and general awareness of nonfarm opportunities it is estimated that not more than one-fourth of the family heads in this group will ever move into nonfarm employment. One male head had accepted nonfarm employment as a construction laborer between the end of 1956 and mid-1957.

It is likely that 30 percent of the group will move into the retired, transfer-payment category by 1965.

Most of the families in this group probably will eventually move into farming, but their potential for success in farming is low. No family in the group had a net worth of $1,000; average net worth was $40. As was indicated earlier, family heads had very little education. Those who move into full-time farming from this group are likely to do so at the small renter or share cropper level.

Other Family Members: In addition to family heads and wives of

TABLE 26.—Family Members Over 14 Years of Age, Other than Head or Wife, Rural Farm Laborer Families[1]

Item	Male	Female
	Number	
Under 30 years of age:		
In school	5	5
Not employed[2], not in school		
Under 5 years schooling	5	1
5-8 years schooling	3	3
9 or more years schooling	2	2
60 years or older or disabled	3[3]	..
Total	18	11

[1] All Negro except one.
[2] Full-time or at $2,000 or more.
[3] Includes one white male.

heads, there were in these 27 families 10 able-bodied males and 6 females not in school and not employed at nonfarm work. The nonfarm employment potential of most of the males was low. Five of them had less than 5 years of schooling, and only two had 9 or more years.

Five of the six females had completed 5 years of school or more.

Family Members Who Had Left Home

Only one male and four females had left these families in the last decade. The male, who had completed 9 years of school, was in military service. Two of the females were housewives and two were farm wage workers.

Miscellaneous Families

Group V consists of 22 families that did not fit any of the other four categories, accounting for almost 4 percent of all of the families in the sample. The group contains seven families whose heads had nonfarm work but at a low rate of pay, three families whose heads were full-time students, four families whose heads were unemployed for health or other reasons in 1956 but had employment in 1957, four families whose heads had full-time employment in 1956 but were largely unemployed in 1957 for health or other reasons, and four families whose heads were farming at the time of the survey but had been in mlitary service or employed at low paying nonfarm jobs in 1956.

The heads of four of these families were nearing retirement under existing welfare programs within a relatively short time. Six of the heads had age, education, or health impediments to nonfarm employment. The rest, slightly more than half of the group, had no major nonfarm employment limitations.

All of the operators in this group who had entered farming in 1957 had done so as renters of small farms. None of them had any capital assets. The only one of the four who had less than 5 years of schooling had been a service station attendent. All were under 30 years of age. It is not likely that any of these operators will remain in farming.

Male heads in Group V who were employed in 1956 worked as store clerks, loggers, construction laborers, or laborers at other jobs.

Two female family heads had nonfarm employment, one as a store clerk and one as a housemaid.

Summary

This report is summarized in three sections, covering (1) family members who had left home since 1945; (2) family members over 14 years of age, other than heads or wives, who were still at home; and (3) existing family units. This reverses the order followed in the body of the report for each group. This is done to facilitate discussion of possible future adjustment prospects, particularly for those groups primarily dependent on farming.

Family Members Who Had Left Home

A recapitulation of the employment activity and location of family members who had left the homes in the sample since 1945 is presented in Table 27.

Fifty-two percent of those who had left home during the 10 years preceding the study were still in the area. The proportion leaving the area was higher for Negroes than for whites, higher for males than for females, and higher for those at the higher educational levels than for those with less schooling. Although Negroes with 9 or more years of schooling were relatively few in number, the proportion who left the area was especially high.

More than a third of the persons who had left the local area had left Louisiana, almost a fourth going to Texas. The proportion of those leaving the area who had moved to Texas was almost twice as large for Negroes as for whites. Within Louisiana, the favorite point for migration was New Orleans, followed by Lake Charles and Baton Rouge.

About 85 percent of the females who had left home since 1945 were primarily housewives. White females with 9 or more years of schooling accounted for two-thirds of the employed females. Twelve percent of the males who had completed 9 or more years of school, 36 percent of those who had completed 5 to 8 years of school, and 46 percent of those who had completed less than 5 years of school were nonfarm laborers.

Slightly more than one-eighth of all males in the group were farmers or farm laborers. This was 33 percent of those who had completed less than 5 years of school, 15 percent of those who had completed 5 to 8 years of school, and 5 percent of those who had completed 9 or more years of school. The proportion of Negroes who had become farmers or farm laborers was about four times as great as the proportion of whites.

TABLE 27.–Distribution of Rural Family Members Who Had Left Home Since 1945, by Occupation and Location, All Sample Families

Item	Males						Females				
	White			Negro			White		Negro		
	Under 5 years school	5-8 years school	9 or more years school	Under 5 years school	5-8 years school	9 or more years school	5-8 years school	9 or more years school	Under 5 years school	5-8 years school	9 or more years school
Occupation						Number					
Professional	..	..	10	..	1	..	..	5	..	..	1
Proprietor	..	..	3	..	..	..	..	..	..	..	..
Clerical	..	..	7	..	2	..	..	9	..	..	..
Sales	.	2	5	..	1	..	1	2	..	..	..
Craftsman	1	9	4	..	3	..	..	..	..	..	..
Operative	..	6	14	1	2	2	..	..	..	1	..
Service work	..	2	1	1	1	4	1	3	2	..	1
Laborer, nonfarm	1	12	4	10	14	6	..	..	..	..	..
Farm laborer	..	..	1	1	2	..	..	..	1	1	..
Farmer	1	3	1	6	6	2	..	..	..	..	..
Student	..	1	2	..	..	1	..	..	..	..	1
Military service	1	..	11	..	3	1	..	..	..	..	..
Unknown or unemployed	..	1	2	1	2	..	..	1	..	..	..
Wife	..	..	..	..	..	..	27	77	7	40	11
Total	4	36	65	20	37	16	29	97	10	42	14
Location											
Local area	2	22	31	10	10	2	22	54	9	26	3
New Orleans	..	3	5	..	6	2	1	10	1	1	3
Baton Rouge	1	4	1	..	1	1	2	8	..	..	2
Lake Charles	..	2	4	3	..	4	1	5	..	3	1
Alexandria	..	..	1	..	..	2	1	3	..	..	1
Elsewhere in Louisiana	..	2	3	1	3	.	..	4	..	2	1
Texas	..	2	5	4	10	3	2	8	..	7	1
Other state	..	1	4	2	3	1	..	5	.	3	2
Military service or unknown	1	..	11	..	4	1	..	..	..	..	..
Total											

Family Members Still at Home

A summary of family members over 14 years of age still at home, other than the heads and wives, is presented by age, education, race, and sex in Table 28. There were 484 such persons among the sample families, or one per 1.2 families.

One able-bodied male for each 4.7 families was not in school and not employed at $2,000 or more. One female for each 6.3 families was in this category. The proportion of persons in this category was more than twice as large for Negroes as for whites.

Throughout this report, it has been assumed that the nonfarm employment potential of persons with less than 5 years of schooling is severely limited. It is assumed that those with 9 or more years have no great nonfarm employment limitation from an educational standpoint. Those with 5 to 8 years of schooling are considered to be moderately handicapped, as they would have some difficulty in finding nonfarm employment that offered much opportunity without additional training. Persons over 45 years of age also are considered to be severely handicapped in obtaining nonfarm employment; those in the 30 to 44-year age group are considered to be moderately limited in this respect.

TABLE 28.—Summary of Family Members Over 14 Years of Age, Other than Head or Wife, by Sex, Race, Age, and Education, All Sample Families

	Males		Females	
Item	White	Negro	White	Negro
Under 30 years of age:				
Employed at $2,000 or more	9	1	3	1
Employed at less than $2,000[1]	2	3	2	3
In school	65	31	56	58
Not in school				
Under 5 years schooling	6	12	1	10
5-8 years schooling	22	32	4	25
9 or more years schooling	18	11	14	16
30-44 years of age:				
Employed at $2,000 or more	3	..	2	..
Employed at less than $2,000[1]	1	..	1	..
Not employed[2]				
Under 5 years schooling	1	6	1	3
5-8 years schooling	2	..	..	..
9 or more years schooling	1	..	..	..
45-59 years of age:				
Employed at $2,000 or more	2	..	..	..
Not employed[2]				
Under 5 years schooling	1	2	1	4
5-8 years schooling	2	..	5	..
9 or more years schooling	1	..	1	..
60 years or older or disabled:	8	7	16	8
Total	144	105	107	128

[1] Full-time.
[2] Full-time or at $2,000 or more.

On the basis of these assumptions, slightly more than one-eighth of the white males in the sample were severely limited in potential for finding nonfarm employment, about one-fifth were moderately limited, and almost two-thirds had no age or educational handicap or already had employment at $2,000 or more.

Of the Negro males approximately one-third were in each of the nonfarm employment potential groups.

Apparently most females, both Negro and white, who leave home do so through marriage. With respect to employment potential, a much smaller proportion of the females have educational limitations than males. The proportion of females with an age limitation is slightly higher than for males, especially among the white females.

Based on the proportions of those males who had left home during the preceding 10 years who had become farmers and farm laborers, it can be expected that a total of *25 to 30, or 10 to 12 percent, of the males still at home will be farmers or farm laborers by 1965.* This assumes, of course, that a high level of external economic activity and growth will be maintained. Considering the proportion of these persons who have some employment limitation, and the ease with which farming can be entered at this level, a decline in economic activity and growth easily could cause this number to be increased substantially.

Existing Families

For purposes of this report, sample families were divided into five major groups, with each further subdivided according to various specified characteristics of families and farms. Bases for family groupings and definitions of groups were given in the introduction and in the individual sections devoted to each group. The distribution of the sample families among the five groups is shown in Table 29.

For summary purposes, farm laborer families are considered together with farm operator families primarily dependent on farming. Income and resources controlled by farm laborer families are highly similar to those of a large segment of the farm operator families. The small group of miscellaneous nonfarm families is not discussed in the summary.

TABLE 29.—Groupings of Rural Families, Central Louisiana Mixed Farming Area[1]

Family group	Percent of rural families in group
1. Families obviously without a major income problem	23
2. Families with obviously limited adjustment potential	25
3. Families primarily dependent on farming	43
4. Farm laborer families	5
5. Miscellaneous nonfarm families	4
Total	100

[1] For definitions see pp. 6-7.

Families Obviously Without A Major Income Problem: Families without a major income problem because of nonfarm employment or property ownership accounted for almost one-fourth of the rural families in the sample. They controlled almost three-fourths of the land resources. A small percentage of these families owned a large percentage of the land owned by the group.

In general, these families do not make effective use of the agricultural resources they control. Few of the farm families earned much from farming above the value of farm-produced food consumed by the family. At least a fourth of these families could increase income significantly through more efficient use of farm resources.

Families With Obviously Limited Adjustment Potential: Families classified as having little or no adjustment potential accounted for about one-fourth of all rural families. They controlled about 12 percent of the land resources. This group received most of its return from farm resources in the form of farm privileges.

Family heads in the group have practically no nonfarm employment potential and are not likely to expand or intensify farming operations. It is likely, however, that many farm families in the group could increase farm incomes by a few hundred dollars per farm by operating sound livestock enterprises.

Families Primarily Dependent On Farming, Including Farm Laborer Families: Families primarily dependent on farming accounted for almost half of the sample families. Only 10 percent of these families had farm incomes of $2,000 or more.

These families utilized their land at a considerably higher level of intensity than families in the two groups previously considered. However, a considerable amount of their land was idle or underutilized, particularly on the larger farms. There was considerable underutilization of family labor, especially on the smaller farms.

Of the families with less than $2,000 farm income, almost three-fifths had severe farm size and capital limitations to increasing farm income. They operated less than 50 acres of land or less than 30 acres of cropland and had net worths of less than $2,000. Most had net worths of less than $1,000 and many had negative net worths. Another 10 percent of those with low farm incomes operated slightly larger farms but had severe capital limitations. Because of land and capital resource limitations alone, the prospects of these families for increasing farm income are poor.

Slightly more than one-fourth of the families with low farm incomes had somewhat stronger capital positions but operated small acreages. About equal proportions of these families had net worths of $2,000 to $4,999, $5,000 to $9,999, and $10,000 or more. Many of these were in a position to expand farming operations either by acquiring more land in place or relocating on a larger farm.

Only slightly more than 3 percent of the families with farm incomes of less than $2,000 operated farms large enough (over 50 acres of cropland or 100 acres of total open land) to sustain a $2,000 farm income and had a net worth of $5,000 or more.

Apart from limitations imposed by lack of land and capital resources most of these families seemed unaware that their lot could be improved and lacked the motivation to seek improvement. The general attitude seemed to be one of acceptance or resignation. This may have been related to levels of age and education. Almost half the heads of families were over 45 years of age. More than three-fifths had completed less than 5 years of schooling; only 8 percent had completed 9 or more years.

As these age and education data indicate, nonfarm employment prospects were poor for most of these family heads. Only one-fourth of the family heads were males under 45 years of age with 5 or more years of school. Only about 6 percent were males under 45 with 9 or more years of school.

Some of these male heads were moving into nonfarm employment. Slightly more than 2 percent of the farm and farm laborer family heads had accepted full-time nonfarm employment at the end of 1956 and remained in the area, either as part-time farmers or as rural residents. Others undoubtedly left the area and were not included in the sample.

It seems possible that up to about 20 percent of the farm family heads, most of them from the small, low-income farms, eventually will move into nonfarm employment.

It also is likely that by 1965 about one-fifth of the farm families will leave full-time farming for retirement or part-time farming, with most of the nonowner families becoming eligible for coverage under the state welfare program and most of the owners renting out their cropland.

Thus, there is a possibility of up to 40 percent of these families leaving the farm and farm laborer groups within the next few years. Given the assumptions of the preceding section with respect to entries of comparable new families into farming, this will represent a net loss to this group of 25 to 30 percent of the families in this category. As was stated, however, the extent to which this reduction is realized will depend primarily upon external economic conditions. In view of the relative instability of the employment to which some of these persons move, the ease of entering farming at the small renter level, and the large number of young persons still at home, an economic setback could result in a quick reversal of the trend toward fewer such families.

Even with the most optimistic estimate of the reduction in numbers of such families, it is not likely that they will drop below 70 percent of present numbers for some years to come. It is not likely that most of those who remain primarily dependent on farming will make much improvement in their income position of their own volition.

Conclusions

There is no quick or simple solution to the problem of underemployment and low incomes among rural people in this area. The situation is not unique with this area or with agriculture. There are many instances of the problem having occurred in other industries—for example, mining and lumbering. It is largely a result of technological innovation. The problem occurs in industry as large quantities of physical resources, highly specific to the industry, are no longer required to maintain the necessary output. These resources usually are highly specific to the industry. Especially for labor resources there may be qualitative, physical, social, or psychological restrictions on movement into other activity. The problem usually is solved only through time as older persons die or retire and as fewer young people enter the industry. In the case of actual unemployment, workers are forced, after a time, to seek other employment for which they may not be well suited and which may yield a low income.

The problem of underemployment and low incomes, however, is more serious in agriculture than it has been in other industries, primarily because of the large number of people involved. There are other complicating factors also. The situation in agriculture is more likely to result in underemployment than in actual unemployment. A family usually can live at a subsistence level on a small, low-production farm. Because of this, the family heads may be less inclined to seek other employment than if they actually were unemployed. The possibility of existence, together with the ease of starting farming operations on a small farm, also causes a flow of resources into agriculture during times of stress in other segments of the economy. A large part of the present problem undoubtedly was caused by the reduced out-migration of farm people and the return of some people to the farm during the last depression. Many of these people may have expected to enter farming only as a temporary measure, but the passage of only a little time was required for their labor resources to become specific to farming.

Therefore, while the problem might be solved through time, as fewer young people enter farming and as older people retire, this solution would require a very long period. The process needs to be speeded up, if possible, for at least three reasons. First, the present situation is one of poverty and human need by current standards. Second, present conditions result in a great waste of human resources, not only in terms of underutilization of existing resources, but also in terms of reduced opportunity for the development of the full potential of young people in these circumstances. Third, the present situation acts as a deterrent to adjustments that are needed to make agriculture more efficient. The full benefits of technological innovation and improvements in production techniques cannot be realized as long as a large segment of agriculture is organized along the lines that existed for a premechanized and subsistence agriculture.

Most students of the problem are agreed that (1) more rural people need to be absorbed into nonfarm employment; and (2) the agricultural resources that are released by those moving into nonfarm employment need to be recombined into larger, more efficient units. Most discussion has been concerned with the first part of the solution and has evolved around either moving more industry into rural areas or accelerating the movement of people out of these areas. Often the assumption that the second part of the solution will automatically follow seems to be implied.

Workers in pilot Rural Development counties generally have found that bringing in new industry is much easier in concept than in fact. Factory sites are not chosen for the purpose of solving local problems or national problems. Often the very conditions underlying the problems of underdeveloped areas act as a deterrent to the introduction of new industry.

The data from this study indicate that age and educational limitations are serious impediments to nonfarm employment of a majority of heads of existing families on low-income farms in the five-parish area. The educational obstacle also exists for some young people in these families. It seems likely that a large amount of underemployment and many low-income families would exist in the area even if there were perfect knowledge of employment opportunities outside the area or if there were a large expansion of industrial activity within the area. Actually, this area cannot be considered highly remote, or completely lacking in knowledge of outside activities. A large part of the area is within 75 miles of either Baton Rouge or Lake Charles, cities which have experienced large industrial growth in recent years. New Orleans is less than 200 miles from the most distant point in the area.

This is not to imply that steps could not or should not be taken to increase the movement of rural people from the area into nonfarm employment. As a minimum, existing educational laws should be more rigidly enforced so that children will not be permitted to reach adulthood only to find that they have few employment opportunities and are able to exercise little choice in occupation. The possibilities for trade school expansion and more student recruitment of youth and young adults in line with existing and prospective employment opportunities could well be investigated. Information on employment opportunities might be more effectively collected and disseminated. The majority of rural youth and some adults have been moving into nonfarm employment. This process could well be accelerated.

It is clear, however, that even if the best possible job were done along these lines, a large part of the problem would remain. Many of these people are virtually unemployable, and others probably should not be encouraged to seek nonfarm employment. It is not certain that all of them would be better off in nonfarm jobs at the level of pay they could command than in their present circumstances. For this large number of existing families, major improvements in income levels probably can be obtained only in farming or through transfer-payment programs.

An attempt to raise these low-income farm families to a level of output and efficiency that would permit acceptable levels of income from farming would require a program of very large proportions. Such a program could be developed and made to succeed for a given area. The existing level of knowledge with respect to technology and management is such that the level of output and efficiency could be raised considerably in any given area. Such a program probably could not be developed or made to succeed with respect to a large number of areas or the overall problem. It is not possible to increase the farm incomes of these families significantly without increasing output. Yet there are few major agricultural products that have not been in oversupply in recent years.

What sort of program would be required in order for this area or similar areas to increase the level of farm incomes? The first requirement would be an intensive educational program. It would be necessary to develop a new spirit among rural people. Such an educational program would need to include information on ways and means, but above all it would have to be directed toward motivation. To a large extent, rural families in low-income categories have never known any other way of life. Most of their neighbors are in similar circumstances. While they undoubtedly are aware that a better life exists they apparently do not see themselves as a part of it. Most habits are hard to break. A way of life is habit to a certain extent and also is hard to break.

Motivation alone, of course, would not solve the problem. The greatest physical need of these families is for larger farming operations. If rural families were properly motivated as to the need for increasing incomes and were made to understand the possibilities of increasing farm income through increasing farm size, many of them undoubtedly could and would expand farming operations. However, a conscious and positive program to increase farm size also would be needed. Recombining of farms does not always occur automatically as families retire or move out of farming. There is a considerable amount of idle and underutilized farm land already in the area. Rural development committees, and existing agencies thoroughly familiar with the area and with local conditions, might be able to accelerate farm combinations and increase land utilization through a program including publicity and personal contact.

There is some indication that existing tenure institutions in this area may be a deterrent to expanding farm size. There was a feeling by many families that additional land could not be operated profitably at prevailing rental rates. This was substantiated to some extent by the lack of success of renter families on farms of medium size. This point needs further investigation.

Coexisting with the need for larger farms is a need for additional capital. Few low-income farm families have a capital position strong enough to finance much farm expansion or improvement. The educational program mentioned earlier would need to include possibilities and motivation for increasing income through use of credit, both for those who do and those who do not have a strong capital position. For those who have few assets, new sources of credit need to be developed. Expansion of Farmers Home Administration operations would seem to offer one promising approach to this problem. However, private lending agencies might well find that some of these families could constitute a profitable outlet for loanable funds, particularly with increased supervision and technical assistance. This possibility needs investigation by private and public lending agencies as well as public research agencies.

A final requirement for increasing farm incomes of low-income farm families is a vast increase in the amount of technical advice and assistance furnished to these families. Individual case histories from the Farm and Home Development Program and experience of the Farmers Home Administration have indicated that remarkable increases in farm income can be obtained through close assistance in improving farm practices and in selecting and combining enterprises. In general, low-income farm families have made little use of the services of the Agricultural Extension Service and the various technical agencies. Many of these families need close personal assistance to a much greater degree than the more successful commercial farm families. The educational level of farm operators in these families is extremely low, technical information reaches them slowly, and there is a greater lack of initiative and imagination than among the more successful farm operators. They need assistance in developing and producing secondary farm enterprises, in basic farm planning which includes selection and combination of enterprises to most effectively utilize available resources, in selection of farm practices to increase output or reduce cost, or both. In short, they need advice and assistance in every phase of modern farming. A part of the educational program would need to be devoted to creating a desire for this kind of assistance. Present resources devoted to this type of activity would not be adequate to provide assistance to the large numbers of farm families involved.

An area willing to undertake a comprehensive program along the broad outlines indicated above undoubtedly could increase the level of rural incomes significantly. As noted earlier, however, if the basic problems in all low-income rural areas are similar to those in this area, the prospects are poor for major short-run improvements with respect to the overall problem. Agricultural income of low-income farm families cannot be increased without encountering the problem of agricultural surpluses. The most that can be accomplished under these circumstances—and this would require a positive program in itself—is an acceleration of the movement out of agriculture by rural youth and young adults with an acceptance of the fact that a great deal of rural poverty will exist for years to come.

Thus the problem of low-income farm families, complex as it may appear in itself, must be considered as finely interwoven with other agricultural problems. The portion of the problem that requires an agricultural remedy—and this portion appears to be large—can be solved only as solutions are found to other questions confronting agriculture. These questions revolve primarily around surpluses, price programs, and acreage allotments.

Appendix

APPENDIX TABLE 1.—Crop and Livestock Labor Requirements Used to Compute the Amount of Family Labor Used in Farming

Item	Unit	Hours Required
Cotton, pre-harvest, tractor power	Acre	36
Cotton, pre-harvest, workstock	Acre	50
Cotton, harvest, hand	Bale	76
Sweetpotatoes, pre-harvest, tractor power	Acre	45
Sweetpotatoes, pre-harvest, workstock	Acre	60
Sweetpotatoes, harvest, hand	Bushel	.33
Corn, pre-harvest, tractor power	Acre	10
Corn, pre-harvest, workstock	Acre	26
Corn, harvest, hand	Bushel	.31
Rice, tractor power	Acre	16
Sugarcane, tractor power	Acre	100
Hay	Acre	15
Soybeans, tractor power	Acre	10
Miscellaneous truck crops	Acre	100
Workstock	Head	90
Milk cows, home milk	Cow	130
Dairy cows, commercial herd	Cow	95
Beef cows	Cow	20
Hogs	Sow	80
Hens	Head	2
Other poultry	Head	1

APPENDIX TABLE 2.—Distribution of Households With Respect to Specified Characteristics, Rural Families Obviously Without a Major Income Problem, All Sample Families

Item	Major income source: property		Major income source: nonfarm work		Total	
	Owned 500 acres or more	Owned less than 500 acres	Farm families	Nonfarm families	Number	Percent
Number of families	6	16	50	62	134	
Race:						
White	6	16	46	57	125	93
Negro	..	..	4	5	9	7
Family type:						
Husband-wife	6	13	48	59	126	94
Female head, no spouse	..	3	..	2	5	4
Male head, no spouse	..	..	2	1	3	2
Age:						
Male heads						
Under 30	..	..	4	12	16	12
30-39	1	..	10	22	33	26
40-49	1	2	19	18	40	31
50-59	3	6	11	6	26	20
60-69	1	2	5	1	9	7
70 or over	..	3	1	1	5	4
Wives and female heads:						
Under 30	..	..	4	23	27	21
30-39	1	..	21	22	44	33
40-49	2	7	12	13	34	26
50-59	3	4	9	3	19	14
60-69	..	3	2	..	5	4
70 or more	..	2	..	..	2	2
Years schooling:						
Male heads						
Less than 5	1	7	10	14	32	25
5-8	3	4	23	27	57	44
9 or more	2	2	17	19	40	31

Continued

APPENDIX TABLE 2. (Continued)

Years schooling: (continued)						
Female heads and wives						
Less than 5	1	11	3	4	19	14
5-8	..	5	25	26	56	43
9 or more	5	..	20	31	56	43
Family members over 14:						
1	..	..	1	..	1	1
2	2	8	27	44	81	61
3	2	3	13	12	30	22
4 or more	2	5	9	6	22	16
Real estate owned, acres:						
None		..	3	15	18	13
Less than 10		..	4	39	43	35
10-49		1	11	2	14	22
50-99		4	12	1	17	13
100 or more	6	9	4	3	22	17
Net worth						
Less than $1,000	..	..	..	15	15	11
$1,000-4,999	..	..	10	19	29	22
$5,000-9,999	..	2	10	14	26	19
$10,000-24,999	..	2	15	7	24	18
$25,000 or more	6	12	15	7	40	30
Economic class of farm						
Class 1	4	..	1	..	5	4
Class 2	1	..	1	..	2	2
Class 3	..	2	1	..	3	2
Class 4	1	2	1	..	4	3
Class 5	..	2	13	..	15	11
Part-time	..	6	11	..	17	13
Residential	..	4	22	..	26	19
Nonfarm	..	..	..	62	62	46

APPENDIX TABLE 3.—Distribution of Households With Respect to Specified Characteristics, Rural Families With Obviously Limited Adjustment Potential, All Sample Families

Item	Major income source: transfer payments		Major income source: farm property	Total	
	Nonfarm families	Farm families		Number	Percent
Number of families	75	41	29	145	. .
Race:					
White	38	27	27	92	63
Negro	37	14	2	53	37
Family type:					
Husband-wife	38	25	22	85	59
Female head, no spouse	33	10	7	50	34
Male head, no spouse	4	6	. .	10	7
Age:					
Male heads					
30-39	1	. .	. .	1	1
40-49	2	. .	2	4	4
50-59	2	3	6	11	12
60-69	16	17	8	41	43
70 or over	21	11	6	38	40
Wives and female heads:					
Under 40	3	2	. .	5	4
40-49	12	5	5	22	16
50-59	18	10	8	36	27
60-69	22	13	10	45	33
70 or over	16	5	6	27	20
Years schooling:					
Male heads					
Less than 5	30	26	13	69	73
5-8	11	3	7	21	22
9 or more	1	2	2	5	5

Continued

APPENDIX TABLE 3. (Continued)

Years schooling: (continued)					
Wives and female heads					
Less than 5	47	26	18	91	67
5-8	23	6	7	36	27
9 or more	1	3	4	8	6
Family members over 14:					
1	21	5	2	28	19
2	39	18	13	70	48
3	9	10	8	27	19
4 or more	6	8	6	20	14
Real estate owned, acres:					
None	38	7	..	45	31
Less than 10	26	4	..	30	21
10-49	9	24	11	44	30
50-99	..	5	15	20	14
100 or more	2	1	3	6	4
Net worth:					
Less than $1,000	47	7	..	54	37
$1,000-4,999	15	12	..	27	19
$5,000-9,999	6	9	4	19	13
$10,000-24,999	6	12	15	33	23
$25,000 or more	1	1	10	12	8
Economic class of farm:					
Class 4	..	2	1	3	2
Class 5	..	5	7	12	8
Class 6	..	3	..	3	2
Part-time	..	6	5	11	8
Residential	..	25	13	38	26
Nonfarm	75	..	3	78	54

APPENDIX TABLE 4.—Distribution of Households With Respect to Specified Characteristics, Group III Families Operating Farms too Small to Earn $2,000 Farm Income

Item	Less than $250 nonfarm employment income to family head		$250 or more nonfarm employment income to family head		Total	
	Nonowners	Owners	Nonowners	Owners	Number	Percent
Number of families	101	38	17	21	177	
Race:						
White	42	22	12	15	91	51
Negro	59	16	5	6	86	49
Family type:						
Husband-wife	97	34	17	21	169	96
Female head, no spouse		2	..	..	2	1
Male head, no spouse	1	2	..	..	6	3
Age:						
Male heads						
Under 30	18	1	8	1	28	16
30-39	25	5	6	10	46	26
40-49	26	12	3	5	46	26
50-59	25	14	..	4	43	25
60-69	7	4	..	1	12	7
Wives and female heads						
Under 30	24	3	8	7	42	25
30-39	26	8	7	6	47	27
40-49	23	9	2	5	39	23
50-59	23	14	..	2	39	23
60-69	1	2	..	1	4	2
Years schooling:						
Male heads						
Less than 5	78	22	6	6	112	64
5-8	20	13	6	11	50	29
9 or more	3	1	5	4	13	7

Continued

APPENDIX TABLE 4. (Continued)

Years schooling: (Continued)					
Wives and female heads					
Less than 5	58	14	5	3	80	47
5-8	34	17	4	13	68	40
9 or more	5	5	8	5	23	13
Family members over 14:						
1	..	2	..	..	2	1
2	51	15	12	13	91	51
3	27	6	3	4	40	23
4 or more	23	15	2	4	44	25
Real estate owned, acres:						
None	101	..	17	..	118	67
Less than 10	..	3	..	6	9	5
10-49	.	32	..	14	46	26
50-99	..	3	..	1	4	2
Net worth:						
Less than $1,000	73	2	8	2	85	48
$1,000-1,999	21	2	4	2	29	16
$2,000-4,999	7	5	4	4	20	11
$5,000-9,999	.	16	1	9	26	15
$10,000 or more	..	13	.	4	17	10
Economic class of farm:						
Class 3	1	..	1	..	2	1
Class 4	25	9	5	4	43	24
Class 5	59	18	9	7	93	52
Class 6	15	8	2	1	26	15
Part-time	1	2	..	5	8	5
Residential	..	1	..	4	5	3

APPENDIX TABLE 5.—Distribution of Households With Respect to Specified Characteristics, Group III Families Operating Farms Large Enough to Approach or Attain $2,000 Farm Income

Item	Farms large enough to approach $2,000 farm income		Farms large enough to earn $2,000 farm income		Total	
	Nonowners	Owners	Nonowners	Owners	Number	Percent
Number of families	30	15	10	16	71	. .
Race:						
White	14	14	9	15	52	73
Negro	16	1	1	1	19	27
Family type:						
Husband-wife	30	15	9	15	69	97
Male head, no spouse	. .	. .	1	1	2	3
Age:						
Male heads						
Under 30	3	. .	1	1	5	7
30-39	5	3	2	2	12	17
40-49	9	6	5	6	26	37
50-59	11	5	2	6	24	34
60-69	2	1	. .	. .	3	4
70 or more	. .	. .	. .	1	1	1
Wives:						
Under 30	3	. .	2	1	6	9
30-39	9	5	2	4	20	29
40-49	8	5	4	6	23	33
50-59	10	5	1	4	20	29
Years schooling:						
Male heads						
Less than 5	19	7	5	2	33	47
5-8	10	5	1	9	25	35
9 or more	1	3	4	5	13	18

Continued

APPENDIX TABLE 5. (Continued)

Years schooling: (Continued)						
Wives:						
Less than 5	15	5	5	2	27	39
5-8	12	7	1	5	25	36
9 or more	3	3	3	8	17	25
Family members over 14:						
1	. .	. .	. .	1	1	1
2	7	9	6	7	29	41
3	10	3	2	4	19	27
4 or more	13	3	2	4	22	31
Real estate owned, acres:						
None	30	. .	10	. .	40	56
10-49	. .	9	. .	5	14	20
50-99	. .	6	. .	3	9	13
100 or more	. .	. .	. .	8	8	11
Net worth:						
Less than $1,000	14	. .	1	. .	15	21
$1,000-1,999	10	. .	2	. .	12	17
$2,000-4,999	5	. .	. .	2	7	10
$5,000-9,999	1	3	6	3	13	18
$10,000-24,999	. .	10	1	4	15	21
$25,000 or more	. .	2	. .	7	9	13
Economic class of farm:						
1	. .	. .	1	1	2	3
2	. .	. .	5	4	9	13
3	2	4	3	5	14	20
4	19	9	.	4	32	44
5	9	. .	1	2	12	17
6	. .	2	. .	. .	2	3

APPENDIX TABLE 6.—Distribution of Households With Respect to Specifi Characterstics, Farm Laborer Families and Miscellaneous Rural Families

Item	Farm laborer families	Miscellaneous famili
Number of families	27	22
Race:		
White	1	18
Negro	26	4
Family type:		
Husband-wife	22	19
Female head, no spouse	2	2
Male head, no spouse	3	1
Age:		
Male heads		
Under 30	7	8
30-39	6	7
40-49	5	2
50-59	4	2
60-69	3	1
Wives and female heads		
Under 30	9	11
30-39	5	5
40-49	4	3
50-59	6	1
60-69	. .	1
Years schooling:		
Male heads		
Less than 5	22	7
5-9	3	7
9 or more	. .	6
Wives and female heads		
Less than 5	9	4
5-8	10	8
9 or more	5	9
Family members over 14:		
1	3	. .
2	12	17
3	4	2
4 or more	8	3
Real state owned, acres:		
None	26	17
Less than 10	1	5
Net worth:		
Less than $1,000	27	18
$1,000-1,999	. .	2
$5,000-9,999	. .	2
Economic class of farm:		
Class 5	1	. .
Class 6	2	. .
Part-time	2	. .
Residential	1	
Nonfarm	21	22

APPENDIX TABLE 7.—Percent of Sample Families Reporting Various Items Used to Reflect Level of Living, by Adjustment Potential Groups[1]

Item	Group 1	Group 2	Group 3		Group 4	Group 5
			Primarily dependent on farming			
	No income problem	Limited adjustment potential	Small farms	Medium-size & large farms	Farm laborer families	Miscellaneous families
Number of families	134	145	177	71	27	22
	Percent reporting item					
Electricity	100	95	95	97	81	95
Telephone	68	23	14	17	11	9
Refrigerator	100	87	82	92	52	86
Home freezer	61	34	36	65	15	14
Television	85	34	33	56	33	55
Radio	93	77	81	90	63	73
Piped house water	87	50	32	59	11	45
Inside bath	83	39	19	45	4	41
Water heater	71	31	14	32	7	32
Automatic washing machine	45	14	6	25	4	27
Electric or gas stove	99	77	63	62	44	82
Car or truck	88	36	69	89	41	64
Good dwelling[2]	67	25	24	32	..	27
Poor dwelling[2]	6	30	34	21	65	27

---

[1] As defined on pages 6-7.

[2] As evaluated by enumerator. The poor dwellings could be described as shacks. The good dwellings were of sound construction and in a good state of repair. The remaining percentage represents dwellings evaluated as fair.

APPENDIX TABLE 8.—Nonfarm Employment Activity of Able-Bodied Members Sample Families, Other than Heads and Wives, Over 14 Years Old and Not in Scho by Adjustment Potential Groups[1]

Group and activity	Male	Female
	Number	
I. Families without major income problem:		
Water well driller	1	..
Plant process operator	1	..
Salesman	1	..
Clerk	..	1
Part-time:		
Truck driver	1	..
Oil field worker	2	..
Carpentry work	2	..
Service station attendant	1	..
Dragline operator	1	..
Tin shop worker	1	..
Dredge boat worker	1	..
Clerical work	..	1
Teacher	..	1
None	15	8
II. Families with limited adjustment potential		
Construction worker	1	..
Teacher	1	2
Logging	1	..
Sawmill work	1	..
Highway work	1	..
Service station operator	1	..
Brick mason helper	1	..
Laundry worker	1	1
Lunch room worker	..	1
Librarian	..	1
Secretary	..	1
Beautician	..	1
Bank teller	..	1
Part-time:		
Delivery truck driver	1	..
Soda clerk	1	
Agricultural processing plant[4]	4	..
Service station attendant	1	
Carpentry	1	
None	17	17

Continued

PPENDIX TABLE 8. (Continued)

roup and activity	Male	Female
	Number	
II. Farm families excluding those in Groups 1 and 2		
On farms too small to earn $2,000 income		
Insurance adjustor	1	..
Saloon clerk	1	..
Store clerk	..	1
Teacher	..	1
Part-time:		
Construction work	2	..
Sawmill work	1	..
Agricultural processing[2]	4	..
Logging	2	..
Trucking	2	..
Highway work	1	..
Lawn work	1	..
Waitress	..	1
Household maid	..	1
Elevator operator		1
None	27	30
On farms large enough to approach or earn $2,000 income		
Surveyor helper	1	..
House mover	1	..
Household maid	..	1
Hospital maid	..	1
Part-time		
Service station attendant	1	..
None	19	17
IV. Farm laborer families		
Part-time:		
Sawmill work	1	..
Household maid	..	1
None	9	5
V. Miscellaneous families		
Store owner	1	..
Office manager	1	..
Clerical work	1	..
Sawmill work	1	..
Fisherman	1	..

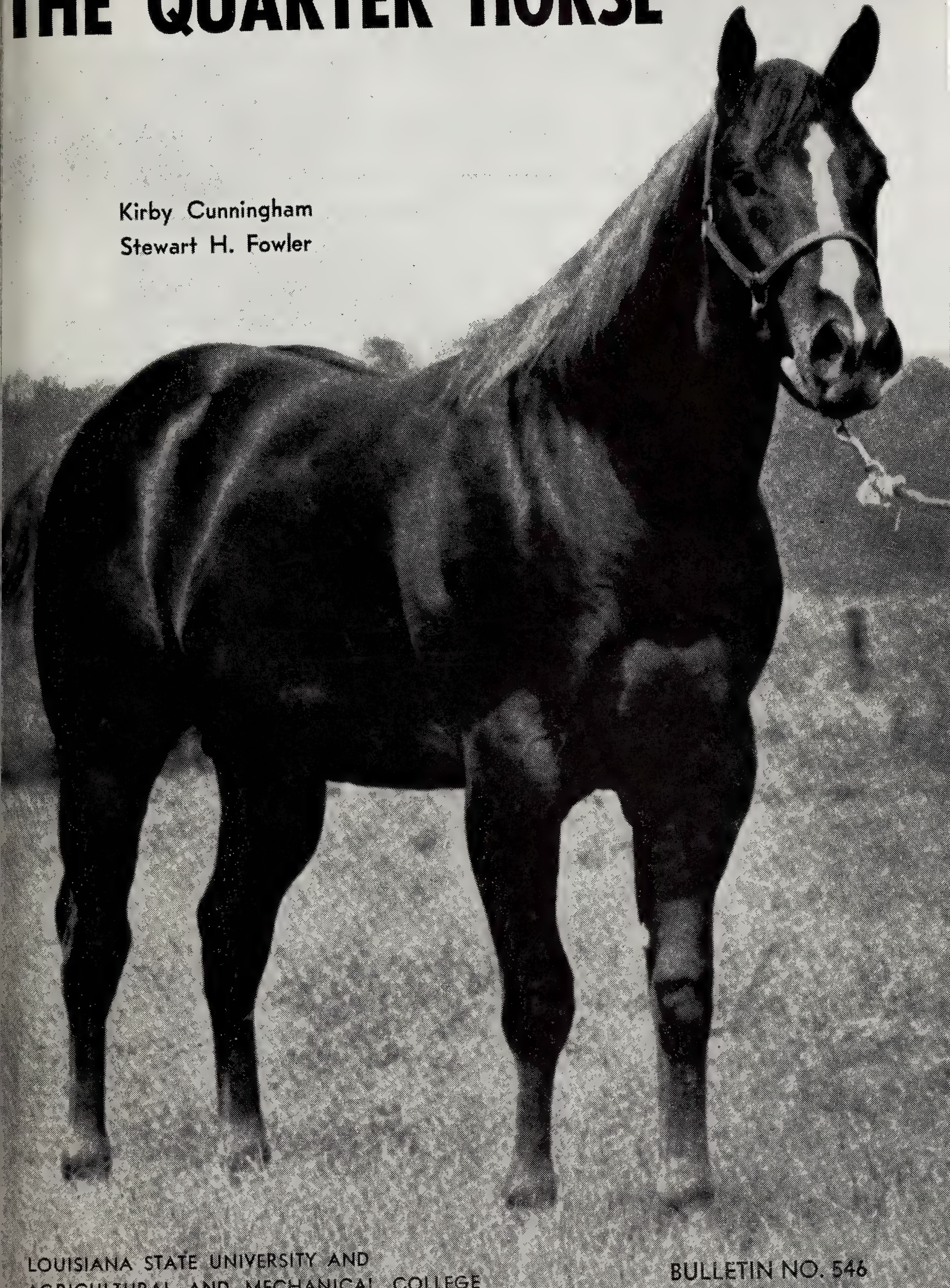
---

[1] As defined on pages 6-7.

[2] Cotton gin, sugar mill, rice drier, potato kiln, etc.

A STUDY OF GROWTH AND DEVELOPMENT IN
THE QUARTER HORSE

Kirby Cunningham
Stewart H. Fowler



LOUISIANA STATE UNIVERSITY AND
AGRICULTURAL AND MECHANICAL COLLEGE
AGRICULTURAL EXPERIMENT STATION
CHARLES W. UPP, DIRECTOR

BULLETIN NO. 546

NOVEMBER 1961

Table of Contents

INTRODUCTION

REVIEW OF LITERATURE

EXPERIMENTAL PROCEDURE

RESULTS AND DISCUSSION

Average Weights and Body Measurements 1

Variability in Weights and Measurements 1

Rate of Development of Various Parts of the Body 1

Relationships Among Weights and Measurements 2

SUMMARY 2

LITERATURE CITED 2

Cover Picture

RED MILLER JR., P-104,969, a young, well-developed Quarter Horse stallion. Note heavy muscling in forearm, gaskin, and chest. When measured at 18 months of age, this horse had already developed the largest circumference of forearm (26 inches) of any horse measured in the study, regardless of age.

A Study of Growth and Development In the Quarter Horse

KIRBY CUNNINGHAM AND STEWART H. FOWLER

Introduction

Probably no breed of animal has gained such widespread popularity in so short a period of time as the American Quarter Horse. In the short period of twenty years, the Quarter Horse, as a breed, has developed to the point where, today, its registry is growing more than three times as fast as any other horse breed registry in the world.

Named for its remarkable speed in short-spurt racing, particularly the quarter mile, the Quarter Horse had its beginning in animals imported from England in 1620. These first mares were crossed with stallions selected from Arab, Barb, and Turk breeds brought to North America by Spanish explorers and traders. The cross produced compact, heavily-muscled horses which could run a short distance faster than those of any other breed. Subsequent infusion of Thoroughbred blood, coupled with a judicious selection program, laid the foundation for today's modern Quarter Horse.

The Quarter Horse's agility, intelligence, quiet disposition, and remarkable endurance, together with its inherent "cow sense," have made this breed ideal for ranch work, rodeo performance, and short track racing. These qualities have earned the Quarter Horse a lasting role on the cattle ranch—a role not to be replaced by jeeps or helicopters.

Despite the widespread acceptance of the Quarter Horse, very little is known about its normal growth and development. A review of available literature revealed a decided lack of such information for light horses of any breed. Knowledge about normal development would be useful for a variety of purposes. It would provide a basis for comparisons among breeding groups and nutritional regimes. It would also serve as a reference point from which to evaluate performance and from which to establish breeding and management objectives.

The purpose of this bulletin is to present data on growth and development of the Quarter Horse under normal conditions. It is hoped that this information may serve as the basis for further much-needed research in horse nutrition, breeding, and management. The study might also be of value in establishing specific and permanent conformation standards for the American Quarter Horse.

Review of Literature

A review of available literature revealed a shortage of data on growth and development in horses. Limited early work was confined to draft horses, leaving a definite need for information concerning light breeds.

In a study of 297 light horses, Dawson *et al.* (1945) found normal growth from birth to 18 months of age under a management system in which the horses were adequately fed. When maintained principally on range pasture thereafter, the animals matured at a somewhat smaller size than would be expected from a higher plane of nutrition. Significant differences in both height and weight were found between breed groups studied. Males tended to be larger than females and appeared to mature more slowly. These differences in sex increased with age up to five years. Weight was affected more than height by adverse conditions. Yearly variations in growth were significant but not consistent in the various breeds.

Trowbridge and Chittenden (1932) reported that skeletal growth of draft colts fed limited grain ration was not noticeably less than that of colts fed more liberally. Periodic weights and measurements showed that 50 to 60 per cent of the total increase in weight occurred during the first year of the colt's life. Approximately 65 to 70 per cent of the total increase in depth and circumference of chest, width at hip points, and size of fetlocks and coronets occurred during the first year. Furthermore, as much as 90 per cent of the total increase occurred in some important dimensions by the end of the colt's first year. During the fourth and fifth years, only slight development was made by any of the colts. The measurements showed a gradual slowing up of the growth process as age increased.

Brody (1927) reported that height at withers in draft horses was the first physical trait to reach maturity. This was followed by circumference of chest and weight.

Crampton (1923b), from a study on 409 American-bred draft colts, established the following growth-weight relationship: One year of age, 50 per cent of mature weight; two years of age, 75 per cent; three years, 90 per cent; and between four and five years, mature weight. This agrees with the work of Trowbridge and Chittenden (1932). A period of very rapid growth followed by a slower one seemed to be the tendency for the first three years. These variations were most marked during the first year of the colt's life. They tended to follow the seasons of the year very closely. Environmental conditions, together with the lessening of normal inherent growth tendency as age advanced, produced these periods of relatively slower growth.

In a second study, Crampton (1923a) stated: "Experience has shown that mares of a certain size mated to a jack of a given weight produce on the average a certain class of mule, which class is determined very rigidly by weight and height." He found that a draft colt's mature weight, at about four to five years of age, depends on many factors. Among the most important are: (1) the inherited tendency to be big, and (2) proper care, feed, and management to develop this inherent tendency to the limit. Experimental evidence indicates that growth is controlled by inheritance. From a study of about 2,000 draft horses, ranging in age from birth to 26 years, Crampton (1923a) found that colts that were well fed from birth gained little—except in fat—after four years of age.

Nye (1948) presented tentative ideal Quarter stallion measurements as set up by the American Quarter Horse Association. These measurements expressed in inches were:

Head and Neck	
1. Poll to nostril	16.0
2. Between eyes	10.0
3. Around nose	18.0
4. Around head at eye	40.0
5. Throat latch	31.0
6. Poll to wither	32.5
7. Length of ears	5.2
8. Width between ears	7.0
Torso	
9. Wither to loin (last rib)	21.0
10. Loin to tailhead	24.5
11. Around chest	83.5
12. Around heart girth	77.0
13. Around flank	74.0
14. Around barrel	80.0
15. Hip to hock	41.0
Fore Leg	
16. Around arm	27.0
17. Elbow to knee	15.0
18. Around knee	13.2
19. Around cannon	8.2
20. Around ankle	10.5
21. Around pastern	7.5
22. Knees to ankle	10.2
23. Ankle to hoof	4.5
24. Around hoof at hair line	13.5
Rear Leg	
25. Around gaskin	22.0
26. Around hoof to hairline	13.0
27. Around hock	17.5
28. Around cannon	9.0
29. Around ankle	11.0
30. Around pastern	8.0
31. Hock to ankle	16.0
32. Ankle to hoof	5.0

Experimental Procedure

This study was conducted to provide detailed data on growth and development in the Quarter Horse. It was initiated on March 18, 1960, at the Louisiana Agricultural Experiment Station, Baton Rouge.

Since large numbers of Quarter Horses were required for this study the cooperation of breeders throughout the state was enlisted to increase the limited number which could be supplied by the Quarter Horse Unit at Louisiana State University. Periodic trips were made to the farms of these breeders to secure measurements and photographs of their Quarter Horses.

The study was designed to investigate the growth of the Quarter Horse at specific periods in development, thus establishing a growth curve for the animal with special emphasis on certain body characteristics relating to type. The intervals studied were: birth, 3 months, 6 months, 12 months, 18 months, 24 months, 36 months, 48 months, and 60 months. Animals were measured at these intervals according to their age.

The following measurements were taken and recorded in the units designated:

1. Head measurements
    a. Length of head (in.)
    b. Width of head (cm.)
2. Neck measurements
    a. Length of neck (in.)
    b. Depth of neck (cm.)
3. Body measurements
    a. Height at withers (cm.)
    b. Length of body (in.)
    c. Width of chest (cm.)
    d. Width of quarters (cm.)
    e. Circumference of heart girth (in.)
    f. Depth of foreflank (cm.)
    g. Depth of hindflank (cm.)
4. Feet and leg measurements
    a. Circumference of forearm muscle (in.)
    b. Foreleg length (elbow to ground) (cm.)
    c. Foreleg length (knee to ground) (cm.)
    d. Hind leg length (hock to ground) (cm.)
    e. Circumference of cannon bone (in.)
    f. Width of cannon bone (mm.)
    g. Depth of cannon bone (mm.)
    h. Circumference of hoof head (in.)
5. Condition score (numerical score)
6. Withers rating (numerical score)
7. Weight (lbs.)

Descriptions of measurements taken are as follows:

1. *Length of head*—the distance from the center of the poll to a line horizontally bisecting the nostrils, as measured with a steel tape.

2. *Width of head*—the horizontal distance across the widest point of the head (at the eyes), as measured with a steel caliper.

3. *Length of neck*—the distance from the anterior top of the withers to the center of the poll, at normal head carriage, as measured with a steel tape.

4. *Depth of neck*—the depth through the shoulderbed, as measured with a steel caliper.

5. *Height at withers*—the vertical distance from the ground to the top of the withers, as measured with a steel caliper.

6. *Length of body*—the distance from the point of shoulder to a straight edge held flush across the point of the buttocks.

7. *Width of chest*—the horizontal distance across the widest point of the shoulders, as measured with a steel caliper.

8. *Width of quarters*—the horizontal distance across the widest point of the quarters, as measured with a steel caliper.

9. *Circumference of the heart girth*—the distance along a steel tape drawn snugly around the body just behind the forelegs and at the base of the withers.

10. *Depth of foreflank*—the vertical distance from the chest floor just behind the forelegs to the top of the withers, as measured with a steel caliper.

11. *Depth of hindflank*—the vertical distance from the flank just forward of the stifle to the top of the back, as measured with a steel caliper.

12. *Circumference of forearm muscle*—the distance along a steel tape drawn snugly around the forearm muscle at the elbow.

13. *Foreleg length (elbow to ground)*—the vertical distance from the ground to the elbow, as measured with a steel caliper.

14. *Foreleg length (knee to ground)*—the vertical distance from the ground to the approximate mid-point of the knee joint on the anterior of the forelimb, as measured with a steel caliper.

15. *Hind leg length (hock to ground)*—the vertical distance from the ground to the point of the hock, as measured with a steel caliper.

16. *Circumference of cannon bone*—the distance along a steel tape drawn snugly around the cannon bone midway between the knee and the fetlock joint.

17. *Width of cannon bone*—the horizontal distance across the cannon bone midway between the knee and the fetlock joint, as measured with a vernier caliper.

18. *Depth of cannon bone*—the horizontal distance from the anterior to the posterior edge of the cannon bone midway between the knee and the fetlock joint, as measured with a vernier caliper.

19. *Circumference of hoof head*—the distance along a steel tape drawn snugly around the coronet of the hoof.

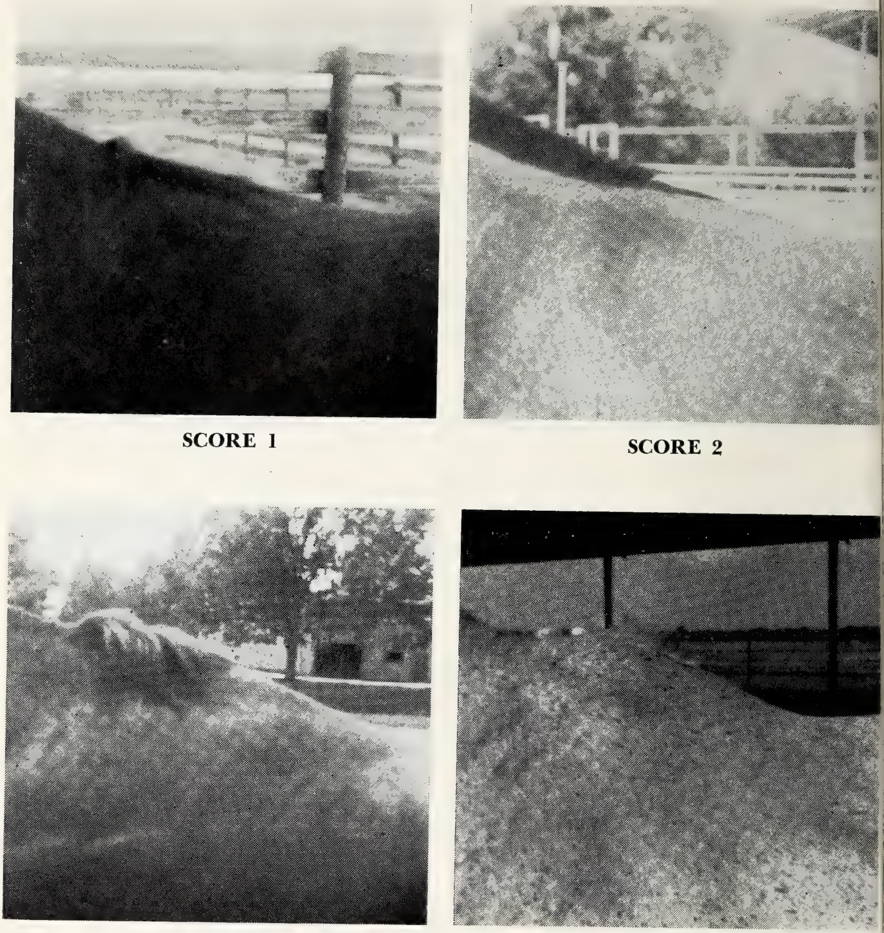
20. *Condition score*—subjective appraisal of the animal with a score assigned according to the following scale: (1) thin, (2) moderate flesh, and (3) fat.

21. *Withers rating*—subjective appraisal of the animal with a score assigned according to the following scale: (1) flat mutton withers, (2) moderately flat, (3) moderately sharp, and (4) sharp (Fig. 1).

22. *Weight*—weight as determined by a single weighing to the closest pound.

At the termination of the study, all metric units were converted to inches, or fractions thereof, for clarity and uniformity.

WITHERS RATING SCORES



SCORE 1

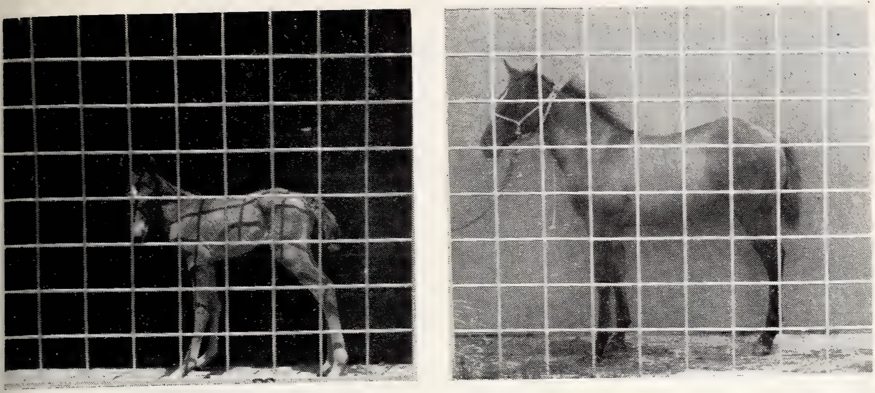
SCORE 2

SCORE 3

SCORE 4

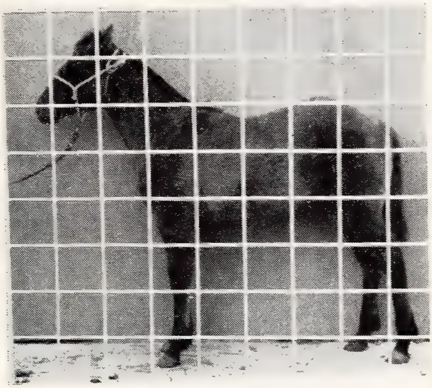
FIGURE 1.—Scores used to define withers of animals included in the study. These scores are defined as follows: Score 1—flat, mutton-type withers; Score 2—moderately flat; Score 3—moderately sharp; Score 4—sharp.

At the time measurements were made on LSU horses, photographs were taken to measure growth and body change visually. The horses were photographed behind a standard grid of squares measuring 8 inches x 8 inches. All photographs were taken at a distance of 16 feet. In this manner it was easy to determine visible body changes and developmental growth from period to period (Figure 2).



Birth—78 pounds

3 months—310 pounds



6 months—462 pounds

FIGURE 2.—Sequence of photographs taken of a Quarter Horse behind a standard photographic grid showing development from birth to six months of age.

Results and Discussion

Size attained at any given age is the result of the combined effect of all factors that determine development of an individual. The pattern of growth is described by the size attained at various times in the life span of the animal. Such growth data become valuable to those interested in comparing individuals or groups of individuals.

Environment, plane of nutrition, inherent growth potential, sex, type, and chance variation are important when measurements or weights of individual animals are compared at the same age or stage of development. In addition, the relative effects of inbreeding, linebreeding, or outcrossing may be important. Any interactions of heredity and environment should also be considered. Over long periods of time, general changes or improvements in management practices and the results of any selection practiced would tend to alter growth or size at a given age.

Table 1.—Means, Standard Deviations, and Coefficients of Variations of Weights and Measurements for Quarter Horse Males from Birth to Five Years of Age

Age	No.	Weight			Length of Head			Width of Head			Length of Neck			Depth of Neck			Height at Withers		
		Av.[a]	S.D.[b]	C.V.[c]	Av.[a]	S.D.[b]	C.V.[c]	Av.[a]	S.D.[b]	C.V.[c]	Av.[a]	S.D.[b]	C.V.[c]	Av.[a]	S.D.[b]	C.V.[c]	Av.[a]	S.D.[b]	C.V.[c]
		lb.	lb.		in.	in.		in.	in.		in.	in.		in.	in.		in.	in.	
Birth	5	102	11	10.8	13.6	.5	3.7	5.6	.7	12.5	12.7	.8	6.3	7.7	.2	2.6	35.9	1.5	4.2
3 mo.	6	304	67	22.0	17.4	.8	4.6	6.7	.4	6.0	18.2	1.5	8.2	11.6	.8	6.9	43.8	1.9	4.3
6 mo.	11	526	61	11.6	19.5	.6	3.1	7.3	.3	4.1	21.7	1.1	5.1	14.1	.7	5.0	49.3	2.0	4.1
12 mo.	7	694	33	4.8	20.9	.6	2.9	7.8	.2	2.6	23.7	1.5	6.3	15.4	.7	4.5	53.6	1.2	2.2
18 mo.	9	976	90	9.2	22.7	1.0	4.4	8.4	.2	2.4	26.8	1.2	4.5	18.2	1.2	6.6	57.2	1.5	2.6
24 mo.	9	1049	102	9.7	22.8	.3	1.3	8.6	.3	3.5	28.3	1.7	6.0	18.5	.5	2.7	58.6	1.8	3.1
36 mo.	3	1112	48	4.3	23.3	.5	2.1	8.9	1.8	20.2	31.0	1.6	5.2	21.0	.9	4.3	59.0	.8	1.4
48 mo.	3	1162	43	3.7	23.3	.2	.9	9.1	.3	3.3	28.0	1.4	5.0	20.4	.7	3.4	59.3	2.0	3.4
60 mo.	13	1201	80	6.7	23.3	.4	1.7	8.8	.5	5.7	29.2	1.3	4.5	20.3	1.0	4.9	60.0	1.5	2.5
Average Mature Size		1201			23.3			8.9			29.1			20.6			60.0		

Age	No.	Length of Body			Width of Chest			Width of Quarters			Circumference of Heart Girth			Depth of Foreflank			Depth of Hindflank		
		Av.[a]	S.D.[b]	C.V.[c]	Av.[a]	S.D.[b]	C.V.[c]	Av.[a]	S.D.[b]	C.V.[c]	Av.[a]	S.D.[b]	C.V.[c]	Av.[a]	S.D.[b]	C.V.[c]	Av.[a]	S.D.[b]	C.V.[c]
		in.	in.		in.	in.		in.	in.		in.	in.		in.	in.		in.	in.	
Birth	5	26.8	1.1	4.1	7.9	.5	6.3	9.4	.7	7.4	31.0	1.3	4.2	12.2	.3	2.5	9.0	1.0	11.1
3 mo.	6	40.7	3.3	8.1	11.9	.9	7.6	14.3	1.1	7.7	45.1	3.2	7.1	17.3	1.1	6.3	13.0	.7	5.4
6 mo.	11	47.6	3.3	6.9	14.4	1.1	7.6	17.3	1.9	11.0	54.4	2.9	5.3	20.5	1.5	7.3	15.1	1.2	7.9
12 mo.	7	53.9	.7	1.3	16.6	.8	4.8	19.3	.9	4.7	60.9	1.6	2.6	23.0	1.2	5.2	15.9	.8	5.0
18 mo.	9	57.7	1.5	2.6	18.8	1.1	5.9	21.4	1.9	8.9	70.4	2.3	3.3	25.9	1.0	3.9	17.5	1.0	5.7
24 mo.	9	61.1	1.5	2.5	19.0	.9	4.7	22.0	1.1	5.0	71.0	5.9	8.3	27.5	.6	2.2	18.6	1.6	8.6
36 mo.	3	59.5	4.4	7.4	19.8	1.2	6.1	23.2	.8	3.4	71.9	1.6	2.2	27.4	.6	2.2	18.5	.7	3.8
48 mo.	3	59.9	.9	1.5	20.6	1.3	6.3	23.8	.5	2.1	72.5	.6	.8	27.4	.5	1.8	18.1	.8	4.4
60 mo.	13	61.9	1.8	2.9	21.5	1.7	7.9	23.6	.9	3.8	73.0	1.7	2.3	27.9	3.0	10.8	18.8	1.1	5.9
Average Mature Size		60.6			21.5			23.5			73.0			27.9			18.8		

Age	No.	Circumference of Forearm Muscle			Elbow to Ground			Knee to Ground			Hock to Ground			Circumference of Cannon Bone			Width of Cannon Bone		
		Av.[a]	S.D.[b]	C.V.[c]	Av.[a]	S.D.[b]	C.V.[c]	Av.[a]	S.D.[b]	C.V.[c]	Av.[a]	S.D.[b]	C.V.[c]	Av.[a]	S.D.[b]	C.V.[c]	Av.[a]	S.D.[b]	C.V.[c]
		in.	in.		in.	in.		in.	in.		in.	in.		in.	in.		in.	in.	
Birth	5	11.8	.8	6.8	25.0	1.0	4.0	14.5	.7	4.8	18.1	.7	3.9	4.5	.1	2.2	1.1	.1	9.1
3 mo.	6	16.1	1.3	8.0	29.1	1.4	4.8	16.1	.8	5.0	20.0	1.0	5.0	5.5	.4	7.3	1.2	.1	8.3
6 mo.	11	18.9	1.2	6.3	31.6	1.8	5.7	17.9	.9	5.0	22.3	.8	3.6	6.3	.4	6.3	1.4	.1	7.1
12 mo.	7	20.2	.6	3.0	33.1	1.2	3.6	17.8	.5	2.8	22.8	.5	2.2	6.9	.1	1.4	1.5	.0	0.0
18 mo.	9	22.6	1.6	7.1	35.6	1.5	4.2	17.9	1.0	5.6	23.0	1.1	4.8	7.5	.4	5.3	1.6	.1	6.3
24 mo.	9	22.7	1.2	5.3	35.9	1.6	4.5	18.3	.8	4.4	23.0	1.2	5.7	7.5	.2	2.7	1.7	.1	5.9
36 mo.	3	22.5	.4	1.8	35.1	.6	1.7	17.2	.3	1.7	23.2	.9	3.9	7.5	.2	2.7	1.7	.1	5.9
48 mo.	3	23.2	2.0	8.6	34.9	.7	2.0	17.4	.3	1.7	23.1	.4	1.7	7.6	.1	1.3	1.8	.1	5.6
60 mo.	13	24.1	1.0	4.1	35.8	1.7	4.7	18.0	.8	4.4	23.3	1.3	5.6	7.9	.4	5.1	1.8	.1	5.6
Average Mature Size		24.1			35.4			17.8			23.2			7.6			1.8		

Age	No.	Depth of Cannon Bone			Circumference of Hoofhead			Condition Score			Withers Rating		
		Av.[a]	S.D.[b]	C.V.[c]	Av.[a]	S.D.[b]	C.V.[c]	Av.[a]	S.D.[b]	C.V.[c]	Av.[a]	S.D.[b]	C.V.[c]
		in.	in.		in.	in.							
Birth	5	1.6	.1	6.3	7.2	.3	4.2	1.8	.4	22.2	1.2	.4	33.3
3 mo.	6	1.9	.1	5.3	9.2	.5	5.4	2.3	.8	34.8	1.2	.4	33.3
6 mo.	11	2.2	.1	4.5	10.7	.8	7.5	2.1	.3	14.3	1.1	.3	27.3
12 mo.	7	2.5	.1	4.0	11.9	.3	2.5	2.0	.0	00.0	2.0	.0	00.0
18 mo.	9	2.7	.1	3.7	13.1	.6	4.6	2.3	.5	21.7	1.4	.5	35.7
24 mo.	9	2.8	.1	3.6	13.4	.6	4.5	2.2	.4	18.2	2.3	.7	30.4
36 mo.	3	2.7	.1	3.7	13.4	.2	1.5	2.0	.0	00.0	2.3	.5	21.7
48 mo.	3	2.8	.1	3.6	14.2	.3	2.1	2.7	.5	18.5	2.7	.5	18.5
60 mo.	13	2.9	.1	3.4	14.4	.7	4.9	2.2	.4	18.2	2.5	1.1	44.0
Average Mature Size		2.8			14.4			2.2			2.5		

[a] Average.

[b] Standard Deviation (±).

[c] Coefficient of Variation.

Table II.—Means, Standard Deviations, and Coefficients of Variations of Weights and Measurements for Quarter Horse Females from Birth to Five Years of Age

Age	No.	Weight			Length of Head			Width of Head			Length of Neck			Depth of Neck			Height at Withers		
		Av.[a]	S.D.[b]	C.V.[c]	Av.[a]	S.D.[b]	C.V.[c]	Av.[a]	S.D.[b]	C.V.[c]	Av.[a]	S.D.[b]	C.V.[c]	Av.[a]	S.D.[b]	C.V.[c]	Av.[a]	S.D.[b]	C.V.[c]
		lb.	lb.		in.	in.		in.	in.		in.	in.		in.	in.		in.	in.	
Birth	6	97	14	14.4	13.4	.7	5.2	5.2	.1	1.9	13.3	1.1	8.3	7.6	.4	5.3	35.7	2.0	5.6
3 mo.	16	328	50	15.2	17.2	.9	5.2	6.6	.3	4.5	19.2	1.7	8.9	11.2	1.3	11.6	44.7	1.5	3.4
6 mo.	26	512	59	11.5	19.3	.6	3.1	7.2	.3	4.2	22.0	1.0	4.5	13.7	.8	5.8	49.5	1.6	3.2
12 mo.	22	733	75	10.2	20.8	.5	2.4	7.9	.3	3.8	25.1	1.2	4.8	15.5	1.7	11.0	53.7	1.3	2.4
18 mo.	15	905	79	8.7	22.1	.7	3.2	8.2	.2	2.4	25.9	1.3	5.0	17.6	.5	2.8	55.8	1.5	2.7
24 mo.	22	949	105	11.1	22.3	.6	2.7	8.4	.3	3.6	27.3	2.8	10.3	18.4	1.0	5.4	56.4	2.1	3.7
36 mo.	12	1072	119	11.1	22.7	.4	1.8	8.5	.2	2.4	28.2	2.1	7.4	18.9	2.1	11.1	57.2	1.0	1.7
48 mo.	9	1154	118	10.2	23.2	.5	2.2	8.7	.3	3.4	29.3	3.0	10.2	19.7	1.7	8.6	58.7	2.3	3.9
60 mo.	60	1172	120	10.2	23.3	.8	3.4	8.8	.4	4.5	27.5	2.2	8.0	18.6	1.5	8.1	58.3	1.5	2.6
Average Mature Size		1172			23.3			8.8			28.1			18.9			58.5		

Age	No.	Length of Body			Width of Chest			Width of Quarters			Circumference of Heart Girth			Depth of Foreflank			Depth of Hindflank		
		Av.[a]	S.D.[b]	C.V.[c]	Av.[a]	S.D.[b]	C.V.[c]	Av.[a]	S.D.[b]	C.V.[c]	Av.[a]	S.D.[b]	C.V.[c]	Av.[a]	S.D.[b]	C.V.[c]	Av.[a]	S.D.[b]	C.V.[c]
		in.	in.		in.	in.		in.	in.		in.	in.		in.	in.		in.	in.	
Birth	6	26.8	1.5	5.6	7.8	.8	10.3	9.7	.9	9.3	30.4	1.5	4.9	11.9	.6	5.0	8.2	.9	11.0
3 mo.	16	40.6	2.8	6.9	12.2	1.1	9.0	14.6	1.2	8.2	46.8	2.6	5.6	17.8	.7	3.9	12.5	.7	5.6
6 mo.	26	47.1	1.7	3.6	14.2	1.0	7.0	16.9	1.1	6.5	54.7	2.7	4.9	21.0	1.0	4.8	14.8	1.7	11.5
12 mo.	22	53.3	1.9	3.6	16.5	1.1	6.7	18.3	.8	4.2	62.3	2.5	4.0	23.8	1.0	4.2	15.7	1.4	8.9
18 mo.	15	56.3	2.2	3.9	18.0	1.9	10.6	20.5	.9	4.4	67.4	2.5	3.7	25.6	1.2	4.7	17.2	1.1	6.4
24 mo.	22	58.2	8.1	13.9	18.0	1.3	7.2	21.0	1.2	5.7	69.1	2.4	3.5	26.6	1.1	4.1	17.5	.8	4.6
36 mo.	12	60.8	3.0	4.9	18.6	1.9	10.2	21.1	1.5	7.1	70.9	3.2	4.5	27.6	.9	3.3	17.9	1.2	6.7
48 mo.	9	62.9	2.7	4.3	19.4	2.1	10.8	22.3	1.0	4.5	73.9	3.9	5.3	29.0	2.0	6.9	18.7	.7	3.7
60 mo.	60	61.8	2.2	3.6	19.0	1.6	8.4	22.0	1.6	7.3	72.3	2.6	3.6	27.9	2.2	7.9	19.2	1.7	8.9
Average Mature Size		61.8			19.0			22.2			73.1			28.1			19.2		

TABLE II. (Continued)

Age	No.	Circumference of Forearm Muscle			Elbow to Ground			Knee to Ground			Hock to Ground			Circumference of Cannon Bone			Width of Cannon Bone		
		Av.[a]	S.D.[b]	C.V.[c]	Av.[a]	S.D.[b]	C.V.[c]	Av.[a]	S.D.[b]	C.V.[c]	Av.[a]	S.D.[b]	C.V.[c]	Av.[a]	S.D.[b]	C.V.[c]	Av.[a]	S.D.[b]	C.V.[c]
		in.	in.		in.	in.		in.	in.		in.	in.		in.	in.		in.	in.	
Birth	6	11.0	.9	8.2	24.4	1.4	5.7	14.1	1.1	7.8	17.8	.8	4.5	4.4	.5	11.4	1.0	.1	10.0
3 mo.	16	15.6	1.5	9.6	29.6	1.0	3.4	16.2	.9	5.6	20.6	1.2	5.8	5.6	.3	5.4	1.2	.1	8.3
6 mo.	26	18.1	1.6	8.8	31.9	1.2	3.8	17.2	.9	5.2	22.0	.8	3.6	6.2	.3	4.8	1.3	.1	7.7
12 mo.	22	19.9	.8	4.0	33.3	1.2	3.6	17.3	.8	4.6	22.2	1.1	5.0	6.9	.3	4.3	1.5	.1	6.7
18 mo.	15	21.3	1.3	6.1	34.6	1.5	4.3	17.5	.9	5.1	22.7	1.0	4.4	7.2	.2	2.8	1.6	.1	6.3
24 mo.	22	21.1	1.3	6.2	34.0	1.5	4.4	17.4	1.2	6.9	22.4	.8	3.6	7.2	.4	5.6	1.6	.1	6.3
36 mo.	12	20.9	1.9	9.1	33.9	1.5	4.4	17.0	.7	4.1	22.1	.8	3.6	7.2	.3	4.2	1.6	.1	6.3
48 mo.	9	21.7	1.6	7.4	35.2	1.0	2.8	17.7	.6	3.4	22.4	1.0	4.5	7.3	.4	5.5	1.7	.1	5.9
60 mo.	60	20.4	1.6	7.8	34.8	1.2	3.4	17.2	.8	4.7	22.5	.9	4.0	7.4	.3	4.1	1.7	.2	11.8
Average Mature Size		21.1			34.5			17.3			22.3			7.4			1.7		

Age	No.	Depth of Cannon Bone			Circumference of Hoofhead			Condition Score			Withers Rating		
		Av.[a]	S.D.[b]	C.V.[c]	Av.[a]	S.D.[b]	C.V.[c]	Av.[a]	S.D.[b]	C.V.[c]	Av.[a]	S.D.[b]	C.V.[c]
		in.	in.		in.	in.							
Birth	6	1.5	.2	12.9	6.9	.3	4.3	1.8	.4	22.2	1.0	.0	00.0
3 mo.	16	1.9	.1	5.3	8.9	1.3	14.6	2.6	.6	23.1	1.0	.6	60.0
6 mo.	26	2.2	.1	4.5	10.5	.6	5.7	2.3	.5	21.7	1.2	.4	33.3
12 mo.	22	2.5	.2	8.0	11.9	.3	2.5	2.2	.5	22.7	1.6	.5	31.3
18 mo.	15	2.6	.1	3.8	12.6	.6	4.8	2.3	.4	17.4	1.8	.7	38.9
24 mo.	22	2.6	.1	3.8	12.9	.6	4.7	2.1	.2	9.5	2.1	.5	23.8
36 mo.	12	2.6	.1	3.8	13.1	.6	4.6	2.3	.6	26.1	2.3	.6	26.1
48 mo.	9	2.6	.1	3.8	13.7	.7	5.1	2.6	.5	19.2	2.7	.8	29.6
60 mo.	60	2.6	.2	7.7	14.0	.7	5.0	2.3	.6	26.1	2.8	.8	28.6
Average Mature Size		2.6			14.0			2.3			2.8		

[a] Average. [b] Standard Deviation (±). [c] Coefficient of Variation.

To propose a growth standard or growth curve for Quarter Horses under "normal" conditions, the assumption is made that the above-mentioned factors are typical of all Quarter Horses. However, the number of factors affecting growth, the difficulty in measuring their effect, and the fact that many of the factors cannot be directly controlled limit the accuracy of such an assumption. Therefore, the usefulness and value of growth data as presented in this bulletin will depend on the similarity between the conditions under which the animals used in this study were being raised and the conditions under which data for comparisons are taken.

Average Weights and Body Measurements

Average weights and body measurements of Quarter Horse males at various ages from birth to maturity appear in Table I. Those for Quarter Horse females comprise Table II.

The mean of average weights and measurements of age groups that showed variation after maturity had apparently been reached was taken as the mature size in both males and females. Because of fewer numbers in the older male age groups, less value should be placed on those average weights and measurements.

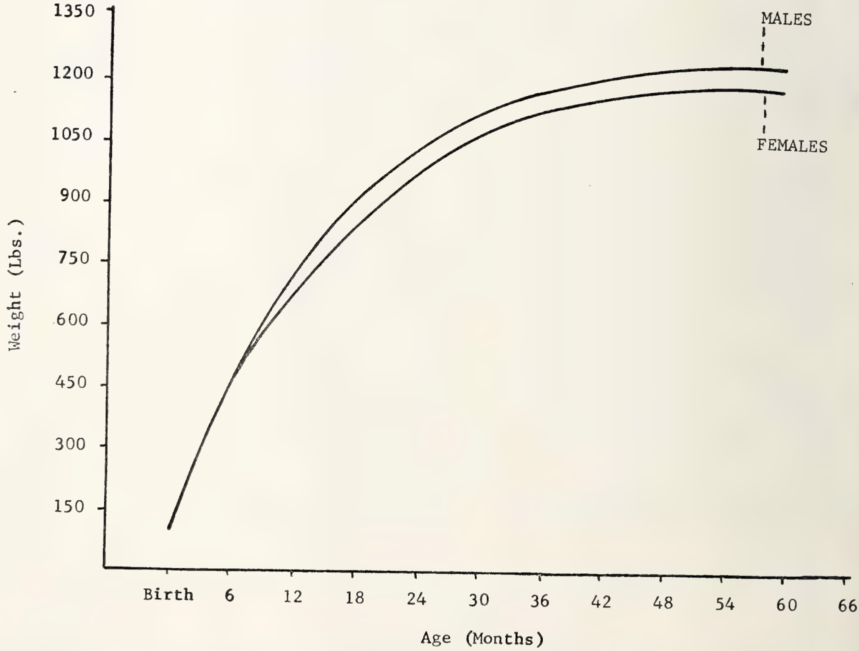


FIGURE 3.—Growth curve (weight) of Quarter Horse males and females from birth to maturity.

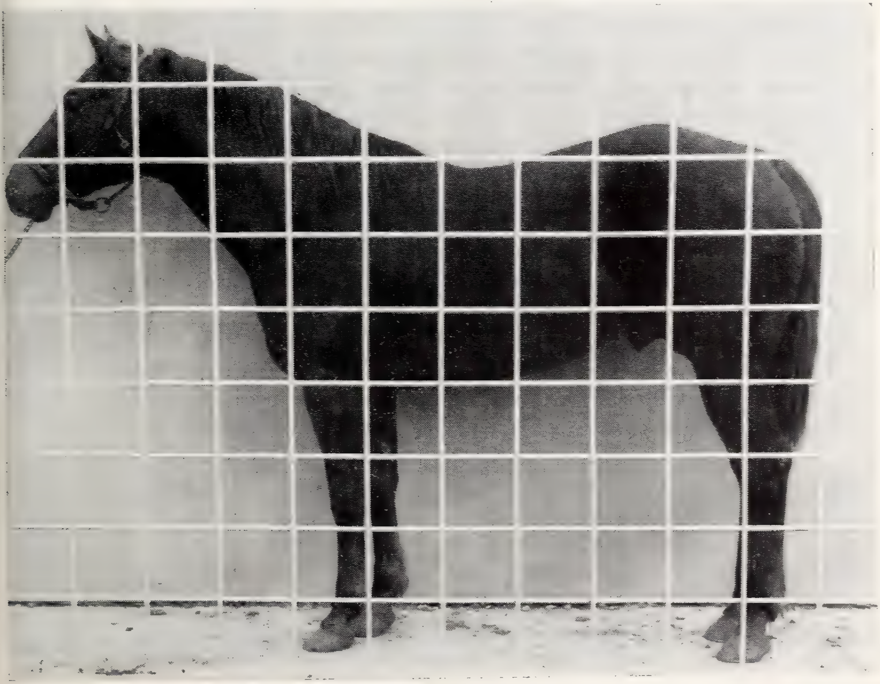
Mature average size in males was larger than in females for all measurements except length of body, depth of foreflank, and depth of hindflank. These findings are in agreement with those of Dawson *et al.* (1945) with light horses. In length of head, the average mature measurement was 23.3 inches for both sexes. In general conformation, both males and females tended to grow uniformly to 18 months of age. At that point, however, the rate of growth in males relative to females gradually increased to five years of age. Growth curves (weight) for both sexes are found in Figure 3.

The greatest difference between mares and stallions in average mature measurements was in circumference of the forearm muscle. Mature mares average 21.1 inches while stallions averaged 24.1 inches.

Most mature Quarter stallion measurements varied considerably from those designated as tentative ideal measurements by the American Quarter Horse Association in the 1940's (Nye, 1948). These tentative standards have since been abandoned by the Association.

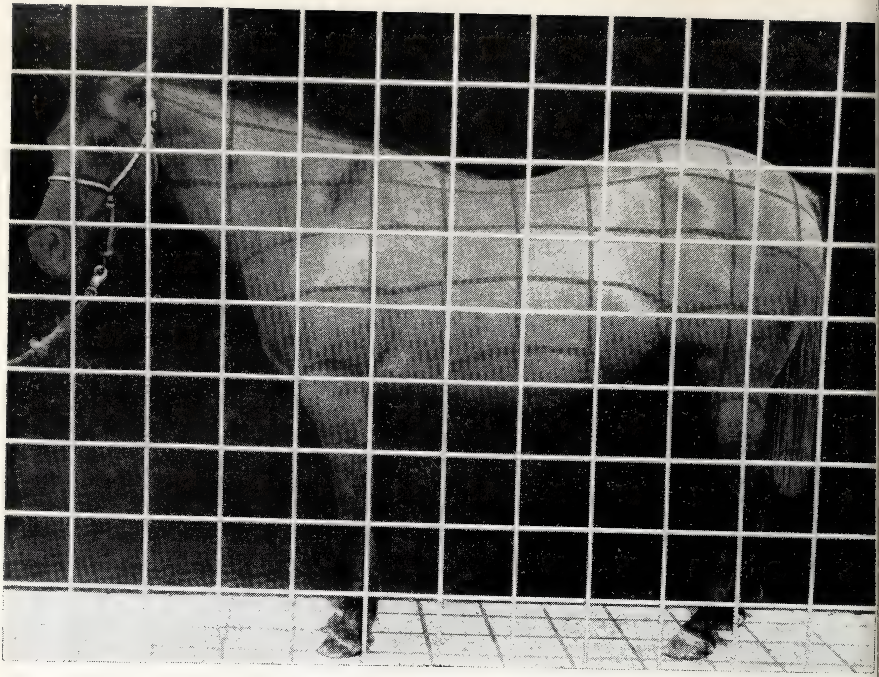
Variability in Weights and Measurements

Since no two animals are phenotypically identical, variability among individuals is useful in making comparisons. The standard deviation was



STICK P-89,006
Age—4 years Weight—1120 pounds

FIGURE 4.—Typical Quarter Horse stallion shown behind standard photographic grid.



PRETTY LULA P-30,739
Age—12 years Weight—1285 pounds

FIGURE 5.—Typical Quarter Horse mare shown behind standard photographic grid.

used to measure differences among Quarter Horses included in this study. This statistical measure, when added to or subtracted from the average weight or measurement at a given age, defines the limits within which approximately two-thirds of a given population of horses—comparable to horses included in this study—would fall.

The standard deviation for weight and most body measurements tended to increase from birth to maturity in both sexes. The larger size of the older animals probably contributed heavily to these greater differences among the more mature animals.

To compare the variability among animals at different ages, the coefficient of variation was computed for each measurement at every age studied. The coefficient of variation is the standard deviation of a measurement at a particular age expressed as a percentage of the average measurement calculated at that age. This statistical measure indicated that as Quarter Horses approach maturity they become relatively more uniform in size. Only depth of neck and width of chest in males and depth of foreflank in females showed a tendency toward more variation at older ages.

The trend toward increased uniformity with approaching maturity was particularly pronounced in the case of weight for both males and females. For males, the standard deviation of 11 pounds at birth represents 10.8 per cent of the average weight. In comparison, the standard deviation of 80 pounds at five years of age is only 6.7 per cent of the average weight. Females had a standard deviation of 14 pounds at birth, which represents 14.4 per cent of the average weight, whereas the standard deviation of 120 pounds at five years of age represents 10.2 per cent of the average weight. This trend was much less obvious for body measurements. This may be due partially to variation in condition and/or to the degree of maturity in a particular measurement at a given age.

The coefficient of variation was also useful in comparing the relative variability of the different body measurements and weight. Weight appeared to be more variable than any of the body measurements. This would indicate less variability among measurements that are influenced most by skeletal development. Those measurements possessing the least amount of variability were length of head and height at withers in both sexes.

Rate of Development of Various Parts of the Body

Knowledge of the rate at which various parts of the body develop is important for two main reasons. First, it aids in evaluating an animal as to conformation or type by placing relative values on various regions of the body with respect to expected percentage of mature size present at a given age. Secondly, it serves as an index to proper feeding and management by pointing out critical periods in growth and development. The percentages of mature size attained by Quarter Horse males and females at various ages appear in Table III and Table IV, respectively.

In general, females approached maturity at a slightly faster rate than males. Linear growth increased faster than width growth in both males and females. This could explain why adverse conditions in later periods of growth seem to exert little influence on linear growth. It also emphasizes the importance of proper feeding and management during the early stages of development.

Height at withers and length of body were two of the earliest maturing linear measurements for males, while in females they matured at about the same time as width measurements. Brody (1927) obtained similar results with draft horses. The present study revealed that about 40 per cent of withers height in horses is present at birth.

Body weight in both sexes was the measurement with the smallest per cent of mature size at birth and was one of the last measures of growth to reach maturity. Only 8 per cent of mature weight was present at birth. At the end of the first year of growth, about 60 per cent of maturity in weight had been obtained. This is in agreement with the findings of Trowbridge and Chittenden (1932) and Crampton (1923b) with draft horses.

Table III.—Percentage of Mature Size Attained at Various Ages by Quarter Horse Males

Age	No.	Weight	Length of Head	Width of Head	Length of Neck	Depth of Neck	Height at Withers	Length of Body	Width of Chest	Width of Quarters	Circ. of Heart Girth	Depth of Foreflank
Birth	5	08.5	58.4	62.7	43.6	37.8	60.0	47.2	36.8	40.0	42.5	43.6
3 mo.	6	25.3	74.8	74.7	62.4	56.2	72.9	67.1	55.4	60.7	61.8	62.0
6 mo.	11	43.8	83.8	81.9	74.7	68.3	82.1	78.6	67.0	73.7	74.5	73.5
12 mo.	7	57.8	89.5	87.6	81.5	75.0	89.4	89.0	77.0	82.1	83.4	82.4
18 mo.	9	81.3	97.3	94.4	92.2	88.3	95.3	95.2	87.4	91.1	96.5	92.9
24 mo.	9	87.3	98.0	96.9	97.4	89.7	97.7	100.0	88.5	93.6	97.3	98.6
36 mo.	3	92.6	100.0	100.0	100.0	100.0	98.4	98.2	92.0	98.9	98.5	98.2
48 mo.	3	96.8	100.0	100.0	96.2	99.1	98.9	98.9	95.9	100.0	99.4	98.2
60 mo.	13	100.0	99.9	98.7	100.0	98.7	100.0	100.0	99.9	100.0	100.0	99.9

Age	No.	Depth of Hindflank	Circ. of Forearm Muscle	Elbow to Ground	Knee to Ground	Hock to Ground	Circ. of Cannon Bone	Width of Cannon Bone	Depth of Cannon Bone	Circ. of Hoofhead	Withers Rating
Birth	5	47.9	49.0	70.7	81.2	78.2	58.7	64.4	56.1	49.9	48.0
3 mo.	6	69.0	66.7	82.1	90.5	86.1	72.0	69.0	69.1	64.1	46.8
6 mo.	11	80.4	78.5	89.2	100.0	96.3	82.2	79.9	79.9	74.0	43.6
12 mo.	7	84.4	83.9	93.5	100.0	98.1	90.9	86.8	88.8	82.9	80.0
18 mo.	9	93.2	93.8	100.0	100.0	99.1	98.8	94.3	96.0	90.7	57.6
24 mo.	9	99.0	94.3	100.0	100.0	99.3	98.4	97.7	99.6	93.3	93.2
36 mo.	3	98.2	93.4	99.2	96.5	100.0	99.1	97.7	98.2	92.8	93.2
48 mo.	3	96.3	96.1	98.6	97.6	99.6	100.0	100.0	100.0	98.8	100.0
60 mo.	13	99.9	99.9	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0

Table IV.—Percentage of Mature Size Attained at Various Ages by Quarter Horse Females

Age	No.	Weight	Length of Head	Width of Head	Length of Neck	Depth of Neck	Height at Withers	Length of Body	Width of Chest	Width of Quarters	Circ. of Heart Girth	Depth of Foreflank
Birth	6	08.3	57.5	59.3	47.4	40.2	61.0	43.3	41.1	43.6	41.6	42.5
3 mo.	16	28.0	73.6	74.4	68.3	59.1	76.4	65.6	64.1	65.7	64.0	63.2
6 mo.	26	43.7	82.6	82.0	78.2	72.6	84.5	76.2	74.6	75.9	74.8	74.8
12 mo.	22	62.5	89.4	89.4	89.1	82.1	91.9	86.2	86.7	84.9	85.2	84.7
18 mo.	15	77.2	94.7	93.5	92.3	92.9	95.4	91.1	94.6	92.4	92.2	91.2
24 mo.	22	81.0	95.8	95.6	97.3	97.1	96.4	94.2	94.7	94.4	94.5	94.6
36 mo.	12	91.5	97.5	96.0	100.0	99.9	97.7	98.4	97.6	95.1	97.0	98.1
48 mo.	9	98.5	99.4	98.5	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0
60 mo.	60	100.0	100.0	100.0	97.8	98.5	99.7	100.0	99.9	99.3	98.8	99.1

Age	No.	Depth of Hindflank	Circ. of Forearm Muscle	Elbow to Ground	Knee to Ground	Hock to Ground	Circ. of Cannon Bone	Width of Cannon Bone	Depth of Cannon Bone	Circ. of Hoofhead	Withers Rating
Birth	6	42.8	52.0	70.6	81.7	80.0	59.7	62.4	58.6	49.3	35.7
3 mo.	16	64.9	73.7	85.8	93.4	92.2	75.8	73.3	74.3	63.6	35.7
6 mo.	26	77.0	85.9	92.5	99.4	98.7	83.4	81.2	83.9	75.1	41.1
12 mo.	22	81.7	94.1	96.4	99.9	99.7	93.8	91.5	95.8	84.7	56.8
18 mo.	15	89.5	100.0	100.0	100.0	100.0	96.9	95.8	99.2	90.2	63.2
24 mo.	22	90.0	99.9	98.5	100.0	100.0	97.0	97.0	100.0	91.9	74.6
36 mo.	12	93.4	99.0	98.4	98.4	99.1	97.0	98.2	98.9	93.6	80.4
48 mo.	9	97.6	100.0	100.0	100.0	100.0	98.8	100.0	100.0	98.0	95.4
60 mo.	60	100.0	96.5	100.0	99.4	100.0	100.0	100.0	100.0	100.0	98.9

Maturity in weight for both sexes was attained at approximately five years of age, with smaller increment changes per unit of time occurring after 18 months of age.

Length of leg was the earliest maturing measurement studied. In both sexes, about 71 per cent of length from elbow to ground and 82 per cent of length from knee to ground were present at birth. Length from knee to ground reached maturity at six months of age, while length from elbow to ground reached maturity at 18 months of age. This indicates that the greatest proportion of increase in length of leg after birth takes place between the elbow and knee. From these findings, perhaps length of leg might be slightly altered by proper feed and management from birth to 18 months of age.

Cannon bone circumference, width, and depth were found to be about 59 per cent mature at birth. Maximum bone growth appeared to be attained between 18 and 24 months of age in both males and females. This emphasizes the importance of supplying adequate amounts of essential vitamins and minerals during the early stages of development—specifically from birth to 24 months of age.

Contrasting development was found between males and females in circumference of forearm muscle. Females appeared to reach maturity in that measurement at about 18 months, while in males mature size of forearm was not attained until almost five years of age. These data support the statement that females are generally faster maturing than males and suggest that size of forearm may be influenced by increased physical activity, which is generally characteristic of stallions.

Withers rating generally increased with age at a uniform rate. Mature accent of withers was reached at about five years of age in both stallions and mares. This observation supports the findings discussed in the following section pertaining to withers development.

Relationships Among Weights and Measurements

In order to study the relationships among body measurements, correlations were calculated between each pair of measurements considering age as a variable, and between each pair of measurements at the nine ages defined in this study. To conserve space, only the first set of correlations are given. They appear in Table V.

Changes in most measurements were highly associated with changes in most other measurements. The positive and significant nature of most of the correlations is consistent with the fact that growth in one part of the body is related to growth in other parts of the body. The magnitude of these correlations indicates that from 35 to 80 per cent of the change in a measurement was associated with changes in other measurements.

The correlations computed at the various ages studied (not shown) substantially supported the figures in Table V although the magnitude of these values was not generally as great.

Table V reveals that heart girth is the measurement most closely associated with weight (r = 0.96). This relationship tends to validate the use of this measurement to estimate weight. About 92 per cent of the differences in weight were associated with differences in the circumference of heart girth. The magnitude of the correlations between weight and the other measurements indicates that their use alone as indicators of weight is probably only slightly better than a visual estimate.

Heart girth was highly associated with depth of foreflank (r = 0.93), height at withers (r = 0.97), length of body (r = 0.95), width of chest (r = 0.92), and width of quarters (r = 0.95). This is significant in that a deep, full heart girth is an indication of strong constitution, which is especially important in horses.

Length of head appeared to be most closely associated with height at withers (r = 0.96), length of body (r = 0.94), weight (r = 0.93), and heart girth (r = 0.96).

In general, width of head in relation to length was closely associated with shortness and thickness of cannon bone, and with shortness, thickness, and heavy weight in relation to height of the animal as a whole. Cannon bone circumference, on the other hand, was very highly correlated with height at withers (r = 0.95).

The correlation between age and forearm muscle circumference was considerably lower than most other relationships (r = 0.51), indicating that muscling is dependent to a large extent upon factors other than age. Only 25 per cent of the change in size of forearm muscle was accounted for by change in age.

The measurement most closely associated with forearm muscle circumference, which is probably the most easily measured indication of muscling in the animal, was width of chest (r = 0.92). This would substantiate many animal husbandmen's belief that as muscling in an animal increases, it tends to force the legs out to the four corners of the body, resulting in a broader, more square-cut animal. Forearm muscle circumference was also highly associated with width of quarters (r = 0.87), which gives further support to this theory.

Age was less associated with knee to ground (r = 0.22) and hock to ground (r = 0.37) than with any other measurements (Table V). Only 5 to 13 per cent of the change in cannon bone length, as measured by knee to ground and hock to ground, was due to change in age. This further indicates that a very high percentage of the length of leg is present in Quarter Horses at birth. Knee to ground and hock to ground were also less associated with all other measurements than most relationships in the study.

Elbow to ground was not highly related to age as compared with relationships between other measurements (r = 0.60), but it was highly correlated with most other measurements. This further substantiates the previous hypothesis that a very high percentage of any change in length of leg after birth occurs between the elbow and the knee.

Table V.—Correlations Among Body Measurements of Quarter Horses[a] [b]

Measurement	Weight	Length of Head	Width of Head	Length of Neck	Depth of Neck	Height at Withers	Length of Body	Width of Chest	Width of Quarters	Circ. of Heart Girth	Depth of Foreflank	Depth of Hindflank
Weight		.93	.90	.88	.92	.94	.93	.90	.93	.96	.91	.89
Length of Head	.93		.91	.89	.91	.96	.94	.86	.92	.96	.92	.89
Width of Head	.90	.91		.86	.88	.91	.89	.85	.88	.91	.86	.86
Length of Neck	.88	.89	.86		.90	.89	.88	.85	.88	.91	.85	.80
Depth of Neck	.92	.91	.88	.90		.92	.90	.89	.91	.93	.88	.83
Height at Withers	.94	.96	.91	.89	.92		.94	.90	.94	.97	.93	.89
Length of Body	.93	.94	.89	.88	.90	.94		.87	.92	.95	.90	.86
Width of Chest	.90	.86	.85	.85	.89	.90	.87		.92	.92	.83	.82
Width of Quarters	.93	.92	.88	.88	.91	.94	.92	.92		.95	.89	.86
Circ. of Heart Girth	.96	.96	.91	.91	.93	.97	.95	.92	.95		.93	.89
Depth of Foreflank	.91	.92	.86	.85	.88	.93	.90	.83	.89	.93		.85
Depth of Hindflank	.89	.89	.86	.80	.83	.89	.86	.82	.86	.89	.85	
Circ. of Forearm Muscle	.81	.83	.79	.82	.83	.87	.81	.92	.87	.86	.79	.77
Elbow to Ground	.83	.86	.81	.78	.80	.92	.85	.83	.85	.87	.78	.81
Knee to Ground	.50	.56	.52	.50	.52	.65	.56	.62	.59	.58	.52	.58
Hock to Ground	.60	.67	.65	.60	.63	.74	.65	.68	.67	.67	.62	.66
Circ. of Cannon Bone	.90	.93	.88	.86	.88	.95	.90	.88	.91	.93	.88	.84
Width of Cannon Bone	.87	.85	.83	.80	.83	.88	.85	.84	.85	.86	.83	.78
Depth of Cannon Bone	.87	.90	.85	.85	.87	.93	.88	.87	.89	.91	.86	.81
Circ. of Hoofhead	.94	.94	.89	.85	.89	.95	.92	.87	.91	.94	.90	.87
Condition Score	.12	.07	.09	.12	.08	.07	.09	.19	.15	.11	.08	.11
Withers Rating	.63	.61	.55	.54	.57	.61	.58	.43	.55	.57	.62	.55
Age	.85	.76	.72	.67	.72	.74	.74	.64	.73	.75	.73	.74

(Continued)

TABLE V. (Continued)

Measurement	Circ. of Forearm Muscle	Elbow to Ground	Knee to Ground	Hock to Ground	Circ. of Cannon Bone	Width of Cannon Bone	Depth of Cannon Bone	Circ. of Hoofhead	Condition Score	Withers Rating	Age
Weight	.81	.83	.50	.60	.90	.87	.87	.94	.12	.63	.85
Length of Head	.83	.86	.56	.67	.93	.85	.90	.94	.07	.61	.76
Width of Head	.79	.81	.52	.65	.88	.83	.85	.89	.09	.55	.72
Length of Neck	.82	.78	.50	.60	.86	.80	.85	.85	.12	.54	.67
Depth of Neck	.83	.80	.52	.63	.88	.83	.87	.89	.08	.57	.72
Height at Withers	.87	.92	.65	.74	.95	.88	.93	.95	.07	.61	.74
Length of Body	.81	.85	.56	.65	.90	.85	.88	.92	.09	.58	.74
Width of Chest	.92	.83	.62	.68	.88	.84	.87	.87	.19	.43	.64
Width of Quarters	.87	.85	.59	.67	.91	.85	.89	.91	.15	.55	.73
Circ. of Heart Girth	.86	.87	.58	.67	.93	.86	.91	.94	.11	.57	.75
Depth of Foreflank	.79	.78	.52	.62	.88	.83	.86	.90	.08	.62	.73
Depth of Hindflank	.77	.81	.58	.66	.84	.78	.81	.87	.11	.55	.74
Circ. of Forearm Muscle		.81	.66	.69	.87	.82	.86	.82	.17	.36	.51
Elbow to Ground	.81		.74	.79	.87	.79	.85	.86	.03	.49	.60
Knee to Ground	.66	.74		.78	.61	.54	.60	.55	.08	.20	.22
Hock to Ground	.69	.79	.78		.69	.62	.68	.67	.02	.30	.37
Circ. of Cannon Bone	.87	.87	.61	.69		.88	.95	.93	.09	.55	.69
Width of Cannon Bone	.82	.79	.54	.62	.88		.79	.87	.08	.55	.67
Depth of Cannon Bone	.86	.85	.60	.68	.95	.79		.90	.01	.55	.65
Circ. of Hoofhead	.82	.86	.55	.67	.93	.87	.90		.07	.62	.85
Condition Score	.17	.03	.08	.02	.09	.08	.01	.07		—.18	.37
Withers Rating	.36	.49	.20	.30	.55	.55	.55	.62	—.18		.73
Age	.51	.60	.22	.37	.69	.67	.65	.85	.37	.73	

[a] Based on 254 horses.
[b] Correlations above .113 significant at 0.05 level.
Correlations above .148 highly significant at 0.01 level.

A strong association appeared to exist between bone size and muscling The highly significant correlations between forearm muscle circumference and cannon bone circumference (r = 0.87), cannon bone width (r = 0.82), and cannon bone depth (r = 0.86) reveal this association These relationships were stronger than those for many other measurements in the study.

There was a highly significant correlation between circumference of hoofhead and all other measurements except knee to ground. The magnitude of these correlations was very high except in relation to withers rating, hock to ground, and knee to ground. In general, this indicates that circumference of hoofhead is proportional to the size and scale of a given animal.

Condition score was not related to any of the measurements. Thus, the degree of finish apparently had little or no effect on other measurements.

Withers rating was negatively associated with condition score (r = —0.18) but highly correlated with age (r = 0.73) (Table V). This points out that withers development is largely determined by the age and condition of the animal. Thin animals have less fat deposited in the area of the withers, making them more pronounced. As a horse develops in maturity, and is ridden more frequently, muscle development in the area of the withers probably replaces fat. Also, as a horse grows considerably older, an atrophy of the muscles in the withers area occurs, thus accenting withers development. Conceivably, length of spinal processes in the thoracic area, specifically the 4th-13th thoracic vertebrae, might have some effect on the variation in withers accentuation at birth.

A side study was conducted during the course of this experiment to determine the extent of relationship between the weight of a mare and the birth weight of her foal. Data were collected on 13 mares foaling in 1960 and 1961 at the Louisiana State University Quarter Horse Unit and on one outside mare. The correlation between weight of mare and birth weight of foal was found to be 0.64, which is significant at the 0.01 level of probability. This agrees with the findings of Crampton (1923a) for draft horses.

Summary

Growth and development of 254 Quarter Horses was studied during the period 1960-61 through analysis of weights and detailed body measurements taken at specific ages from birth to five years of age.

Mature average size was larger in males than females for all measurements except length of body, depth of foreflank, and depth of hindflank. Both sexes tended to grow uniformly to 18 months of age. At that point, the rate of growth in males relative to females gradually increased to five years of age.

Greatest average mature measurement difference between mares and stallions was in circumference of forearm muscle. Most mature Quarter stallion measurements varied considerably from those designated as tentative ideal measurements by the American Quarter Horse Association in the early 1940's.

There was a tendency for the standard deviation for weight and most body measurements to increase from birth to maturity in both sexes. As indicated by the coefficient of variation, Quarter Horses become relatively more uniform in size as maturity is approached. Weight appeared to be more variable than any of the body measurements studied, indicating less variability among measurements influenced most by skeletal development.

Generally, females approached maturity at a faster rate than males. Linear growth increased faster and tended to mature earlier than thickness growth. Height at withers and length of body were two of the earliest maturing linear measurements for males. In females, these two measurements matured at about the same time as width measurements.

Body weight in both sexes represented the smallest percentage of mature size at birth and was one of the last measures of growth to reach maturity.

Analysis of the data indicated that length of leg (elbow to ground) was approximately 71 per cent mature at birth in both sexes. Length of cannon bone as measured by knee to ground and hock to ground was about 82 per cent mature at birth. Length from knee to ground appeared to reach maturity at six months of age, while length from elbow to ground increased until about 18 months of age. Thus, the greatest increase in length of leg after birth occurred between the elbow and knee.

Females apparently reached maturity in circumference of forearm muscle at about 18 months of age. In males, mature size of forearm muscle was not attained until five years of age.

Withers development became more acute with age, reaching maturity at about five years of age in both stallions and mares.

Changes in most measurements were highly associated with changes in most other measurements. Heart girth appeared to be the measurement most closely associated with weight.

The correlation between age and forearm muscle circumference was considerably lower than most other relationships. Forearm muscle circumference was highly related to width of chest.

Highly significant correlations between forearm muscle circumference and cannon bone measurements indicated a strong association between bone size and muscling in an animal.

Withers rating was negatively correlated with condition score but highly associated with age, thus supporting the theory of some that withers development—or accent—is largely determined by the age and condition of a given animal.

The experimental data also indicated a strong relationship between weight of a mare and size of foal at birth.

Literature Cited

Brody, Samuel. 1927. Growth and development. VIII. Relation between weight growth and linear growth with special reference to dairy cattle. Mo. Agr. Exp. Sta. Bul. 103.

Crampton, E. W. 1923a. Size in the draft horse. J. Agr. and Hort 26:157-158.

Crampton, E. W. 1923b. Rate of growth of draft colts. J. Agr. and Hort 26:172.

Dawson, W. M., R. W. Phillips, and S. R. Speelman. 1945. Growth of horses under western range conditions. J. Animal Sci. 4:47-54.

Nye, N. C. 1948. *Outstanding Modern Quarter Horse Sires.* Second Edition. William Morrow and Company. New York.

Trowbridge, E. A., and D. W. Chittenden. 1932. Horses grown on limited grain rations. Mo. Agr. Exp. Sta. Bul. 316.

Control of Botrytis Rot Of Strawberries

N. L. Horn and P. L. Hawthorne

Bulletin No. 547 **November 1961**

Louisiana State University
and
Agricultural and Mechanical College
Agricultural Experiment Station
Charles W. Upp, Director

Contents

Page

Description of the Disease 3

Determination of the Cause of Rot 5

Methods of Screening Fungicides 6
  Laboratory Methods 6
  Field Methods 6

Results of Field Screening Tests 8

Farmer Cooperative Fungicide Tests 11

Evaluation of the Fungicides 11

Fungicides Recommended for Rot Control 13

Varietal Susceptibility 13

Summary 14

Bibliography 15

Control of Botrytis Rot of Strawberries

N. L. Horn and P. L. Hawthorne*

Description of the Disease

The fruit rot disease of strawberries called gray mold is caused by the fungus *B. cinerea.* The organism attacks not only the fruit but any part of the strawberry plant. This was shown by Payette (*17*)[1], who was able to obtain tissue cultures of *B. cinerea* from all plant parts. The author also was able to isolate the organism from petioles, leaves, fruit, sepals, crowns, and peduncles. Klinkenberg (*9*) described a Botrytis rot of young leaves and flower stalks of strawberry.

The presence of strawberry infection is usually not noticed until the fruit begin to rot (Fig. 1). Sometimes it is noticed sooner than this, especially when the fungus causes blossom blight (Fig. 2). Nevertheless, by the beginning of the fruiting season the fungus becomes so well established that, if optimum conditions of moisture and temperature prevail for several days, significant losses occur.

When strawberry plants are set in the field there are always a few leaves that die as a result of the transplanting. Because the fungus is a saprophyte and lives from year to year in the soil on dead organic material, it is able to build up rapidly on these dead or senescent leaves at the base of the plants. In addition the fungus can be carried on plants

---

*Associate Professor, Plant Pathology, and Professor, Horticulture, respectively.

[1] Italic numbers in parentheses refer to Bibliography on Page 15.

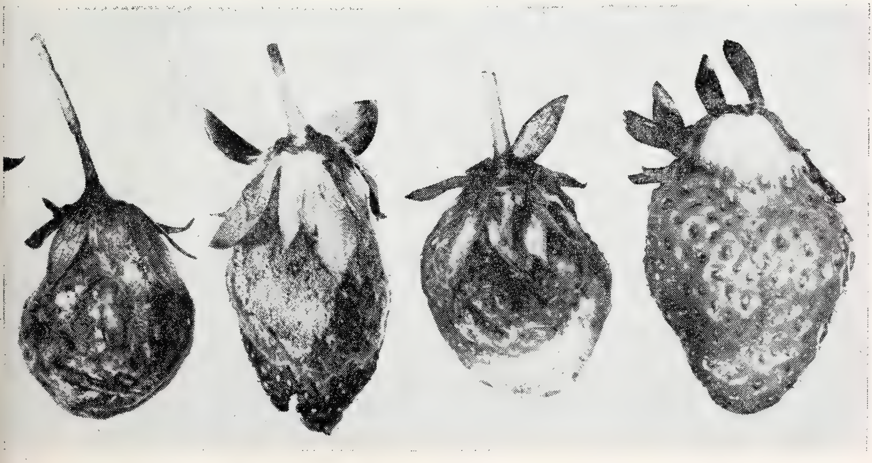


FIG. 1.—The three Headliner berries on the left are infected with *Botrytis cinerea.* The one on the right is a healthy fruit.

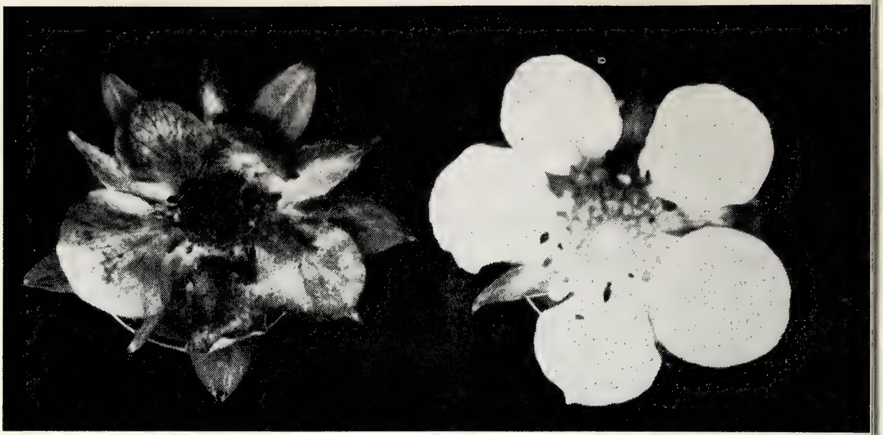


FIG. 2.—Left: The infected flower from a Headliner plant artificially inoculated with *B. cinerea*. Right: A healthy blossom.

from season to season. Under these circumstances the organism becomes established easily under favorable growth conditions in the spring of the year. When the fungus sporulates on the lower senescent or dead leaves, the wind carries the spores to the fruit or to the blossoms where they become lodged in the floral parts. The work of Powelson (*21*) indicated that infection of senescent stamens and calyces is the primary pathway of infection by which *B. cinerea* gains entrance to the fruit. The spores germinate under favorable conditions, and the fungus causes a flower blight (Fig. 2) or a fruit rot (Fig. 3). Not only ripened berries but also green immature fruit (Fig. 3) rot rapidly under certain conditions.

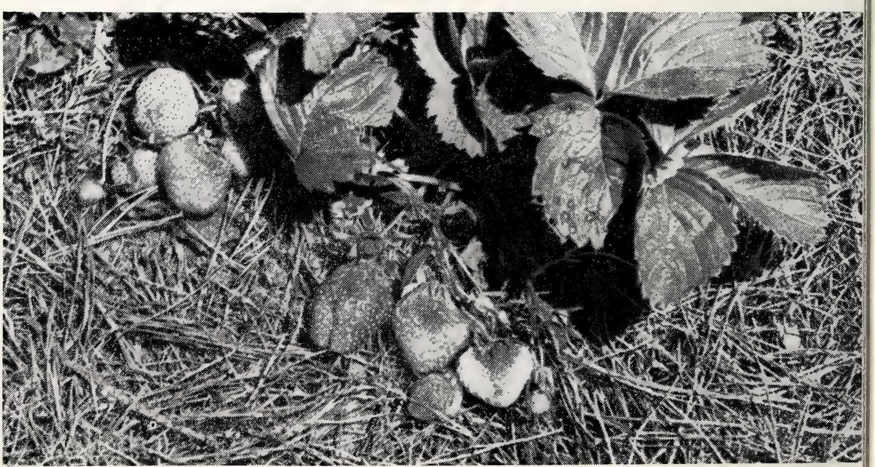


FIG. 3.—Rotted fruit on Headliner plants in the field. Note that even the unrip fruit are infected.

The infected areas appear as spots of a chocolate brown color which are usually found at the calyx end of the berries (Fig. 3). They are easily separated from the healthy tissue—the diseased spot can be pushed out easily with one's finger. Infection sometimes involves the entire fruit, in which case the whole fruit turns brown, is soft and then becomes gray. This gray color is the masses of spores (Fig. 1, center infected berry) produced by the fungus and from which the rot gets the name gray mold. The spores are produced in such large numbers that they appear as a dust puff when blown vigorously. When the spores land on other strawberry fruit, they cause a new infection if conditions for growth are favorable. They of course infect blossoms (Fig. 2), peduncles (Fig. 4), or other plant parts. Discarded or rotten fruit thrown in row middles often become covered with spores and act as a constant source of current inoculum. A continuous supply of inoculum during the fruiting season can build up sufficiently to cause more than 50 per cent rot.

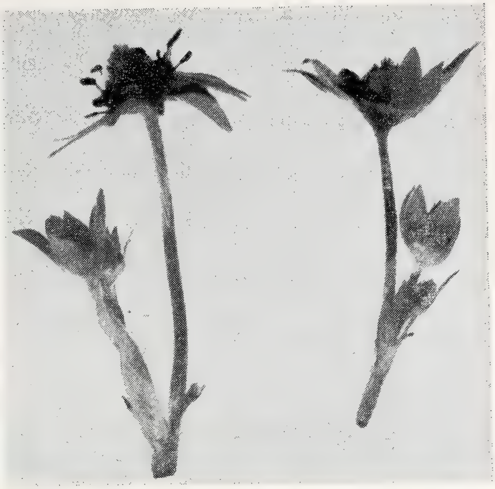


FIG. 4.—Infected peduncles or flower stalks of Headliner plants artificially inoculated with *B. cinerea*. The dark areas are the infected tissue.

If rotted fruit remain undisturbed, they become dry and hard and form what is called a mummy. These dried fruit are masses of mostly fungus tissue which withstand an unfavorable environment for long periods, so that the fungus remains in a dormant condition until the following fruiting season when proper temperatures and moisture cause it to become active again.

Determination of the Cause of Rot

In 1951 a thorough investigation was made at the Louisiana Experiment Station to determine the cause of fruit rot of strawberries. Several thousand tissue cultures from infected fruits were transferred to potato-dextrose agar. From these tissue transfers *Phytophthora* sp., *Rhizoctonia* sp., *Colletotrichum* sp., *Pezizella lythri* (Desm.) Shear and Dodge, *Dendraphoma* sp., and *B. cinerea* developed. The latter was found consistently with infected fruit and was considered to be by far the major fungus involved in the fruit rot complex. Lowings (*10*) in 1955 reported that *B. cinerea* was among the three fungi that were found 98-99.5 per cent of the time in strawberry fruit rot complex.

Since 1950, many workers (*1, 2, 3, 4, 5, 6, 7, 8, 11, 12, 13 14, 15, 16, 18, 19, 20, 21, 22, 23*) from various countries have contributed to the chemical control of strawberry fruit rot.

Methods of Screening Fungicides

Laboratory Methods

In an intensive program to find a control for gray mold, fungicide which included organic and inorganic chemicals and antibiotics were screened in the laboratory. Two methods were used. One was the conventional slide method in which fungicides were sprayed on microscope slides and allowed to dry. Spore suspensions (water + 1 per cent yeas extract + 2 per cent dextrose) of the fungus were then added to the slides and the slides placed in high humidity chambers. The per cen germination was recorded 24 to 72 hours later.

The other method of screening fungicides was called the "fruit dip" method (*5*). Immature berries in the white stage were immersed in suspensions containing one of the various fungicides and conidia o the fungus. The fruit were placed immediately in a specially constructed high humidity chamber and stored at room temperatures, which ranged from 75°-85° F. The number of berries that rotted in each treatment was recorded. Two controls were used. One was nontreated fruit, and the other was fruit dipped in a conidial suspension only. The reason two controls were used was based on the fact that some of the fruit were already infected from field spores before they were used in the test. This infection was not advanced enough to produce visible symptoms on the fruit, but the fungus had penetrated deeply enough into the fruit cells to be protected from the surface fungicide treatments. Each test was run for six days.

Field Methods

After a fungicide had been laboratory tested and found to be fungicidal to *B. cinerea* as well as suitable for field application, it was used in field trials to further test its effectiveness. Many of the fungicides which prevented spore germination in the laboratory screening tests did not give good control in the field.

The one problem that hindered the testing of fungicides in the field was the absence of long enough periods of high humidity. Because the fungus required prolonged periods of high humidity to produce enough rotted berries for evaluation of the materials tested, a specially constructed series of nozzles which sprayed water continuously around the plants was used to induce rot (Fig. 5). This system, with a little assistance from natural humidity, provided fairly good conditions for the development of the disease. About 45 treatments, not including the controls, were tested under these conditions.

Field plots were 32 feet long with 50 plants double-set on 42-inch

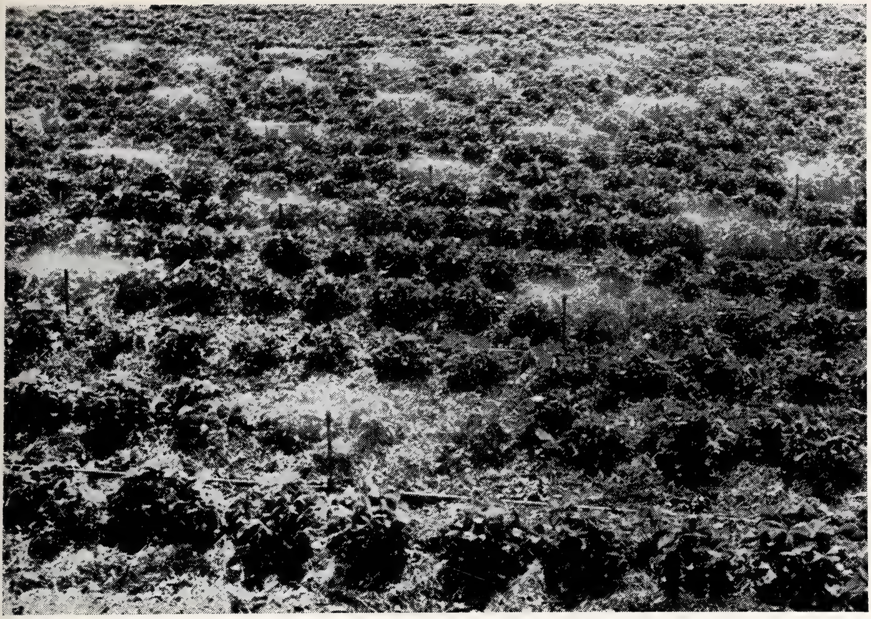


FIG. 5.—An area in the field showing the sprinkler system used to induce berry rot. The light spots throughout the photograph were produced by water sprayed parallel to the ground by a special type nozzle mounted on a 15-inch riser.

rows. The plants were grown under the same cultural practices that growers used. They were mulched so that the pine needles were spread between the rows as well as on top of the rows. The plants were sprayed periodically with Kelthane for mite control and Malathion for cutworm control. Heptachlor was broadcast around the berry plants to control slugs and snails.

The fungicide spray programs were started when the blossoms began to appear, usually sometime during February. Some treatments were continued into the harvest period, depending on the type of fungicide. Those which were known to have a high mammalian toxicity were not used during the harvest period. Fungicides which contained mercury, for example, were discontinued some time before harvest. It was thought that the latter might have a place in rot control, such as a supplementary spray with captan. The materials were applied with a 50-gallon John Bean sprayer using about 200 pounds pressure with the spray directed to get good coverage under the plants as well as on top.

The fungicides were applied at various rates depending on the material. Some fungicides were more phytotoxic than others; thus there were variations in the concentrations used. For example, some materials such as thiram and captan were used at 4 pounds per acre, whereas others such as Dyrene and dichlone were used at ½ pound or less. Attempts were made to follow a 7-10 day spray schedule. If, however, there was a heavy rainfall between the scheduled applications, the materials were sprayed immediately after the rain.

Captan was used as a field control instead of no treatment. There were special reasons for this. In the early work of screening fungicides, captan was found very effective against *B. cinerea* and had the advantage of having a high tolerance. Such a combination was hard to find, and the problem actually became a search for a material with improved fungicidal properties and with a low tolerance. In addition, the plants were set on 42-inch rows, which meant that the plots were very close, considering that the fungus produces air-borne spores. Because of the close proximity of plots, one treatment had an influence on the neighboring one. Powell (*19*) pointed out a similar circumstance. Therefore, a control plot of no treatment would have had more inoculum being spread to the adjoining rows than a control plot in which captan was used. Furthermore, during the course of the investigations, captan had become a recommendation. Actually then, as stated above, the most recent tests were more or less a search for a material superior to captan.

Results of Field Screening Tests

It was pointed out in the previous section that laboratory candidates that were considered worth trying in the field were tested in an area that was equipped with a special sprinkler system designed to maintain higher humidity than normally in order to induce rot. The rotted and healthy berries, respectively, harvested from these plots were counted. The per cent rot was obtained for each plot by dividing the total number of berries harvested into the number of rotted ones and multiplying the quotient by 100. Although captan, Phaltan, Dyrene, dichlone, thiram, ziram, and DHA-S were the most promising materials and each was tested under this system, not all are included in the following discussion.

The results of the 1960 tests are shown in Table 1, in which the total

TABLE 1.—Per Cent Rot of Konvoy and Headliner Berries from Plants Sprayed with Various Fungicides, 1960

Reps.	Harven	Dyrene	Fungicide X	Captan	Phaltan	Thiram
			KONVOY			
1	20.0	12.3	15.7	9.5	8.9	16.0
2	14.6	10.9	18.1	10.5	7.1	15.4
3	15.1	10.9	20.4	8.4	9.8	13.4
Means	16.6	11.4	18.1	9.5	8.60	14.9
L.S.D. 1% = 4.3						
5% = 3.1						
			HEADLINER			
1	9.2	6.9	14.5	5.1	6.0	7.4
2	9.4	7.2	16.4	6.7	5.8	6.7
3	15.0	9.7	16.6	3.9	4.1	11.0
Means	11.2	7.6	15.8	5.2	5.3	8.4
L.S.D. 1% = 4.5						
5% = 3.3						

TABLE 2.—Per Cent Rot of Konvoy and Headliner Berries from Plants Sprayed with Various Fungicides, 1959

Reps.	Captan	Dyrene	Fungicide X-1	Fungicide X-2	Fungicide X-3	Thiram
			KONVOY			
1	14.8	11.9	29.0	18.3	24.7	18.0
2	7.6	11.0	24.6	13.3	20.7	9.8
3	4.6	9.5	33.5	10.7	41.5	5.1
Means	9.0	12.5	29.0	14.1	28.9	10.9
L.S.D. 1% =	15.9					
5% =	11.5					
			HEADLINER			
1	6.5	15.6	20.2	10.2	22.2	3.0
2	1.8	8.9	22.7	10.6	28.5	1.4
3	2.9	3.1	24.2	10.8	14.5	3.2
Means	3.7	9.2	22.3	10.5	21.7	2.5
L.S.D. 1% =	9.6					
5% =	7.0					

rots for four consecutive harvests during the period of greatest infection, which extended from the latter part of April to the middle of May, are recorded. The per cent rots of the Headliner and Konvoy varieties were analyzed separately. The mean per cent rots of the treatments in the Headliner group were similar to the corresponding ones in the Konvoy group except in the case of thiram. There was no significant difference between the mean per cent rot of the captan and thiram treatments when Headliner was the test variety, whereas there was a significant difference between the same treatments when Konvoy was used as the test plant.

In the 1959 tests (Table 2), captan, Dyrene, and thiram were significantly more effective than the two poorest fungicides, X-1 and X-3. The fungicide X-2 was as effective in control as captan, but this material was discontinued by the chemical company that produced it. Each variety was analyzed separately so that each had separate sets of L.S.D. figures. The data were taken during the heaviest rot period, which occurred during the last two weeks of April.

During 1957 the rot was as severe as in any other year in the course of the investigation. Weather conditions and the spray system helped to produce rots as high as 86 per cent in the Konvoy variety and 38 per cent in the Headliner variety. Table 3 indicates the amount of rot that occurred under good conditions for the development of the fungus. The table also lists the average yields in crates per acre that were obtained. The yield data shown here were not for the entire season, but were recorded during a consecutive number of days on which rots were most prevalent. The yields in general reflected the per cent rot that occurred in any one treatment. For example, to note the extreme, Fungicide 3 treated Konvoy and Headliner plants yielded berries at the rate of 15.8 and 32.2 crates per acre and the per cent rots were 86.0 and 38.6 per cent, respectively, whereas captan treated Konvoy and Headliner plants yielded

TABLE 3.—Mean Per Cent Rot of Fruit and Yields in Crates per Acre of the Headliner and Konvoy Varieties Sprayed with Different Fungicides in the Field, 1957

Sprays	Mean Per Cent Rot		Mean Yields	
	Headliner	Konvoy	Headliner	Konvoy
Captan + Fungicide 3	10.0	35.0	35.2	21.2
Fungicide X-1	25.0	71.0	37.1	20.1
Captan (control)	7.3	22.0	47.3	30.8
Thiram	7.9	21.0	44.8	28.5
Fungicide X-2	6.6	34.0	40.0	21.0
Fungicide 3	38.6	86.0	32.2	15.8
L.S.D. 5%	10.6	42.7	11.1	5.7
1%	14.4	58.7	18.2	7.8

berries at the rate of 30.8 and 47.3 crates per acre, respectively. In general, when the per cent rot was high, the yields were low, and vice versa. This was particularly true in the case of the Konvoy variety.

To briefly demonstrate the effect of the rot on yields, however, an earlier test with the Klondike variety pointed out that plants treated with captan, Experimental Fungicide 5400, and DHA-S during the course of the entire season produced higher yields than nontreated plants. Table 4 gives the results of these tests and shows that when the yields were high, the rot was low, and vice versa. For example, nontreated plants yielded 251 crates per acre for the season with 26.5 per cent rot, whereas captan treated plants produced 441 crates per acre with 9.9 per cent rot.

Perhaps these differences in per cent rot do not seem very large. However, a difference of 10 per cent between the poorest and best fungicides was significant in dollars and cents. If for example, a grower spent $7.00 per acre for spray materials for a 7-day period and he harvested 50 crates an acre during this time with each crate netting $4.00, he would have more than paid for the material. A 10 per cent loss at this rate is 5 crates, or $20.00, per acre. Consider the difference of approximately 31 per cent in Table 3 between captan and the poorest fungicides used on the Headliner plants. Here this loss was tripled, amounting to $60.00 an acre. The data, therefore, show that captan can be used economically in berry rot control.

TABLE 4.—The Yields and Per Cent Rot of Treated and Nontreated Field-Grown Klondike Plants

Treatment	No. Rotted Berries	No. Healthy Berries	No. Plants Tested	Yields in Crates/A.	Per Cent Rot
DHA-S	210	1276	73	301	14.1
5400	226	1521	73	348	12.9
Captan	222	2011	75	441	9.9
Control	445	1233	78	251	26.5

Farmer Cooperative Fungicide Tests

Candidates that were considered effective enough against the organism in the field screening procedures to become possible recommended materials were used in outfield tests in commercial plantings. These were thiram, captan, ziram, DHA-S, and Fungicide 5400, all of which were discontinued except for thiram and captan. During the course of these experiments rot became a problem on several occasions. On those occasions captan treated plants produced significantly higher yields than nontreated plants. Plots ranged in size from 1,500 to 3,000 plants, some single and others double set, which were sprayed in a 7 to 10 day schedule that began about the first of March. Harvests were made and the data were recorded by the growers. No efforts were made to record the numbers of rotted berries. Thus the data were records of the yields, which were taken usually during the periods of greatest rot. It was believed that yields of packed berries reflected the amount of rot in the various plots, that is, when rot was high, yields were low, and vice versa.

At location 1, Hammond, the yields of berries from captan and Fungicide 5400 treated Headliner plants were compared with the yields of berries from nonsprayed Headliner plants. Yields were recorded from April 10 to May 1, which included nine harvests. When the data were analyzed, it was found that the yields of berries from the captan treated plants were highly significant over the yields from the nontreated plants and those from the Fungicide 5400 treated plants significant over the nontreated plants. During the three-week period the average number of pints from the captan and Fungicide 5400 treated plants were 63.0 and 58.4 pints, respectively. Significance at the 1 and 5 per cent levels was 13.3 and 9.9 pints, respectively. The average number of pints of berries from the nontreated plots was 45.6.

At location 2, Ponchatoula, yields of five harvests were recorded from Headliner plants from April 5 to May 2, when rot was greatest. The yields of berries from captan and Fungicide 5400 were compared with the yields of berries from nontreated plants. The mean yield from captan sprayed plants was 35.8 pints, whereas the mean yield from comparable nontreated plants was 23.4 pints. A difference of 11.68 pints was needed for significance at the 5 per cent level. The yields from plants sprayed with Fungicide 5400 were not significant over those from nontreated plants.

At location 3, Independence, the grower indicated captan controlled rot significantly during a rainy period. His data showed that rot was 5 per cent in captan treated plots as compared to 30 per cent in control plots.

Evaluation of the Fungicides

It is not necessary to list all the fungicides tested in this investigation. However, the materials used in field trials from 1951 through 1960 which were considered most suitable for field application are discussed briefly.

Thiram (tetramethylthiuramidisulfide), according to Stoddard and Miller (*22*), gave better control of gray mold than did captan (N-trichloromethylthio-4-cyclohexene-1-2-dicarboximide) and for longer periods after spray application. The tests at the Louisiana State University Experiment Station indicated that there is no significant difference between them in rot control. Thiram, however, has a lower tolerance and cannot be applied to strawberry fruit less than three days before harvest, whereas captan can be used at any time during the harvest period. This has been the big advantage of captan over thiram. In addition, captan has been observed to control leaf spot caused by *Mycosphaerella fragariae* (Tul.) Lindau. Although thiram was not evaluated for this property at the Louisiana State University Experiment Station, Cox and Winfree (*2*) reported that it was least effective of the fungicides used in field tests for the control of leaf spot. Because the leading strawberry variety is susceptible to leaf spot, certainly a choice of fungicide would be important here. On the other hand, Parry and Wood (*15, 16*) were able to develop a strain of *B. cinerea* resistant to captan, which they were unable to do with thiram.

The carbamates tested were of little value in control of gray mold. The dimethyl group were weakly fungicidal to the fungus, whereas the ethylene group did not get past the laboratory screening stage. Ziram (zincdimethyldithiocarbamate) showed some control. Cox and Winfree (*2*) indicated that repeated applications of nabam (disodiumethylenebisdithiocarbamate) + zinc sulfate or zineb (zincethylenebisdithiocarbamate) appeared to increase Botrytis gray mold. No such indications were noted in the work presented here. Stoddard and Miller (*22*), although their tests were carried out with plants in the greenhouse, showed that nabam and ziram gave poor control of the disease.

Dichlone (2,3-dichloro-1-4-naphthoquinone) and Dyrene (2,4-dichloro-6 (0-chloroanilino) triazine) controlled gray mold as well as captan, but again the fact that captan has a much greater tolerance eliminated these two candidates temporarily. Both dichlone and Dyrene burned the foliage at the higher concentrations used. Lowering the concentration to a safe level, however, did not reduce the effectiveness of control. Cox and Winfree (*2*) reported that these materials caused leaf damage in the form of bronzing and some stunting.

DHA-S (sodium salt of dehydroacetic acid) appeared to be a promising material in the field. It has a high tolerance and was rated high in the first field screening test. The material, however, caused fruit burn or at least a brown discoloration on the light exposed surface of the berries and sometimes produced a leaf chlorosis. When DHA-S was used at the start of these investigations, the spray was made from the technical material, which might have had some effect on phytotoxicity. The same fungicide formulated by the Dow Chemical Co. as Harven showed no toxicity at the lower concentrations. Nevertheless, in field tests with Harven, this material did not give as good control as captan.

Phaltan (N-trichloromethylthiophthalimide) gave as good control of the disease as did Captan. But again the higher tolerance of captan over Phaltan eliminated the latter.

Fungicides Recommended for Rot Control

On the basis of the experimental results captan and thiram are recommended for the control of gray mold of strawberries.

The Pure Food and Drug Administration has set a tolerance of 100 ppm for captan on strawberries. Captan sprayed on strawberries at 3.8 pounds active material or 7.6 pounds formuated material per acre will not exceed this tolerance. Captan is sold under the commercial names Orthocide 50 Wettable (50%) and Stauffer Captan Garden Spray (50%). It should be applied to strawberry plants starting about the middle of February in a 7-10 day spray schedule.

Thiram (commercial name: Thylate) is packaged as a 65 per cent wettable powder and has a 7 ppm tolerance. This tolerance will not be exceeded if thiram is applied at the rate of 3.25 pounds of active material or 5 pounds of the formulation per acre three days or longer in advance of harvest. Berries treated with thiram and harvested sooner than the three-day period must be washed. This means that the material was intended to be used on berries for processing and not on fruit for fresh market use. Thiram should be used in a 7-10 day spray schedule.

Read the labels carefully for the use of both captan and thiram on strawberries before spraying with either fungicide.

Varietal Susceptibility

Eleven lines of strawberries were tested in the laboratory for resistance by the "fruit dip" method. White berries collected from the field were dipped in conidial suspensions, then placed in moisture chambers of high humidity for six days at 75°-85° F. Controls were fruit not dipped in conidial suspensions and placed in similar containers. The numbers of berries that rotted during the six-day period were recorded. The totals of three tests are given in Table 5.

All lines were considered susceptible although some appeared somewhat less susceptible than others. Nevertheless, the fungus was able to infect readily any of the commercially grown berries tested. Therefore fungicide treatment would be recommended for fruit rot on any of these varieties.

In a separate series of tests it was found that the varieties Tuzzalino Bell and Tuzzalino Beauty were also susceptible. Seventy-five per cent of the fruit from these varieties rotted in four days when placed in the moisture chambers.

In the field the question of susceptibility is somewhat altered because of the growth habits of the various varieties. Varieties that have short peduncles or fruit stalks so that the fruit is held tightly under the plant

TABLE 5.—The Number of Berries from Various Seedlings and Varieties Rotted by *B. cinerea* in the Laboratory "Fruit Dip" Method[1]

Variety or Seedling Number	Numbers of Berries Rotted[2] Number of Days after Inoculation 1	2	3	4	5	6
Klondike control	0	0	0	1	2	6
Klonmore control	0	2	5	5	9	12
Klondike	0	11	13	16	21	25
Klonmore	0	16	20	24	27	29
Konvoy	0	10	16	24	25	25
Marion Bell	0	11	20	22	24	26
0-161	0	4	8	11	14	19
742	0	7	11	14	15	18
0-242	0	13	18	18	19	21
Headliner	0	6	11	17	18	26
0-187	0	13	24	25	26	29
0-162	0	9	15	17	23	24
L-27	0	4	11	17	19	23

[1] Ten berries for each variety or seedling were used in each of three different tests. Therefore 30 berries of each variety or seedling were tested.

[2] The number of rotted berries was totaled on each day. Therefore the numbers in each column are accumulated figures.

are more subject to rot than the contrasting type with long peduncles with fruit set away from the foliage. The reason for this is that moisture remains much longer under the plants. Extended periods of high humidity are conducive to spore germination and growth of the fruit rot fungus.

Summary

The disease gray mold of strawberries is caused by *B. cinerea*. This was determined by the repeated isolation of the fungus from fruit and various other plant parts.

Many fungicides, including organic and inorganic compounds and antibiotics, were screened in the laboratory by the conventional slide method and by the "fruit dip" method. Many of these candidates prevented spore germination but were either unsuitable for field testing or did not perform well in the field.

Phaltan, Dyrene, dichlone, thiram, DHA-S, and captan were the most effective materials used to control the disease. They were tested on plants that were grown in an area that was kept wet with a specially constructed watering system to induce rot. Captan is considered the best fungicide for commercial use because of its high mammalian tolerance in addition to its effectiveness in control of *B. cinerea* and *Mycosphaerella fragariae*. Thiram is recommended for the control of fruit rot only.

All varieties of berries tested were found susceptible to *B. cinerea*, determined by the "fruit dip" method of inoculation in the laboratory.

Bibliography

1. Becker, R. F., *et al.* 1958. Post harvest treatment to control strawberry fruit rot. Plant Dis. Reptr. 42 (9) : 1066-1068.
2. Cox, R. S., and J. P. Winfree. 1957. Observations of the effect of fungicides on gray mold and leaf spot and on the chemical composition of strawberry plant tissue. Plant Dis. Reptr. 41 (9) : 755-759.
3. Frick, E. L. 1955. Laboratory tests of the effects of fungicides on the spore-germination of *Botrytis cinerea* Pers. Ex. Fr. Ann. Reptr. East Malling Res. Sta. (England) 1954: 149-151.
4. Horn, N. L. 1952. Strawberry fungicide screening tests. Plant Dis. Reptr. 36: 309-310.
5. ____________. 1956. A method for testing fungicides in the laboratory for controlling Botrytis fruit rot of strawberries. Phytopathology 46: 15.
6. ____________. 1960. Spraying to control strawberry fruit rot. La. Agr. 3 (2) : 14-15.
7. Ingram, J., *et al.* 1957. An observation on the control of strawberry mildew. Plant Pathol. 6 (2) : 63-64.
8. Kirby, A. H. M., *et al.* 1955. Strawberry Botrytis rot (grey mould) control: a field trial of captan at East Malling. Jour. Hort. Sci. 30: 220-224.
9. Klinkenberg, C. H. 1950. Wortel en stengelziekten van aardbeien. Mededel. Direct. Tuinbouw. 13 (9) : 758-765.
10. Lowings, P. H. 1956. The fungal contamination of Kentish strawberry fruits 1955. Appl. Microbiol. 4 (2) : 84-88.
11. Marsh, R. W., *et al.* 1955. The control of Botrytis rot (grey mould) of strawberries, and the effects of fungicide spray residues on the processed fruit. Jour. Hort. Sci. 30: 225-233.
12. Miller, P. M., and E. M. Stoddard. 1959. Control of gray mold on strawberries. Plant Dis. Reptr. 43 (6) : 646-648.
13. Moore, M. H., and R. P. Tew. 1955. Greenhouse testing of fungicides against Botrytis rot (grey mould) of strawberry and other soft fruits. Jour. Hort. Sci. 30: 213-219.
14. Miller-Stoll, W. R. 1950. Versuche zum Problem der Wirksamkeit von Seifen-und Seifenersatzmitteln gegen Traubenschimmel (Botrytis cinerea). Phytopathology Zeitschr. 17 (3) : 265-286.
15. Parry, K. E., and R. K. S. Wood. 1959. The adaption of fungi to fungicides: Adaption to captan. Ann. Appli. Biol. 47 (1) : 1-9.
16. ____________ and ____________. 1959. The adaption of fungi to fungicides: Adaption to thiram, ziram, ferbam, nabam, and zineb. Ann. Appl. Biol. 47 (1) : 10-16.
17. Payette, Albert. 1954. Gangrenes dufraisier. Candaian Jour. Agric. Sci. 34 (2) : 187-197.
18. Powell, Dwight. 1952. The effect of early spring fungicides on *Botrytis cinerea.* Plant Dis. Reptr. 36: 97-98.
19. ____________. 1953. An evaluation of chemical treatment for the control of *Botrytis cinerea* on strawberry. Phytopathology 53 (9) : 482.

20. ____________. 1954. The effect of captan on gray mold rot incidenc and yield of strawberry. Plant Dis. Reptr. 38:209-212.

21. Powelson, R. L. 1960. Initiation of strawberry fruit rot caused b *Botrytis cinerea.* Phytopathology 50 (7) : 491-494.

22. Stoddard, E. M., and P. M. Miller. 1956. Control of gray mold o strawberries under greenhouse conditions. Plant Dis. Reptr. 40 (5) 443-445.

23. Thompson, B. D. 1958. Post-harvest chemical treatments for th control of strawberry fruit rot. Proc. Amer. Soc. Hort. Sci. 71: 224 230.

louisiana's human resources

Part I

Number, Distribution, and Composition of the Population, 1960

Alvin L. Bertrand

DEPARTMENT OF RURAL SOCIOLOGY
LOUISIANA STATE UNIVERSITY AND
AGRICULTURAL AND MECHANICAL COLLEGE
AGRICULTURAL EXPERIMENT STATION
CHARLES W. UPP, DIRECTOR

Bulletin No. 548
November 1961

Foreword

This is the first of a series of bulletins based on the 1960 Decennial Census to be published by the Department of Rural Sociology. These reports are being prepared to serve the primary purpose of providing a readily accessible source of information on the characteristics of the people of Louisiana. A second objective is to point out population trends which have significance for future planning and development within the state.

The present report presents basic general information on the number, distribution, and composition of the population. It will be followed by a detailed study of the differentials between people living in rural areas and the inhabitants of towns and cities. A third publication is planned as a source book for detailed information on all possible aspects of the 1960 population of the state.

All data in this bulletin are from the various census publications of the United States, unless otherwise noted.

A. L. Bertrand

Table of Contents

Page
Foreword . . . 2
Number of Inhabitants and Population Growth . . . 5
Distribution of the Population . . . 10
Composition of the Population . . . 12
    Sex Composition . . . 12
    Color Composition . . . 14
    Age Composition . . . 17
    Residence Composition . . . 20
Selected General Social and Economic Characteristics of the Population . . . 23
    Educational Attainment . . . 23
    Income Level . . . 25
    Fertility Rates . . . 25
    Employment Status . . . 25
Summary and Implications of Population Changes . . . 27

List of Tables

Page
1. Louisiana Population Growth, by Residence, 1810-1960 . . . 7
2. Louisiana Population Growth, by Parishes, 1950-60 . . . 8
3. Population Growth of Incorporated Places of 10,000 or More and Urbanized Areas in Louisiana, 1950-1960 . . . 11
4. Population Distribution According to Sex, Louisiana, by Parishes, 1960 . . . 12
5. Population Distribution According to Race, Louisiana, by Parishes, 1960 . . . 14
6. Population Distribution According to Selected Age-Groups, Louisiana, by Parishes, 1960 . . . 18
7. Population Distribution According to Residence, Louisiana, by Parishes, 1960 . . . 22
8. Population Distribution According to Education, Family Income, and Fertility Rate, Louisiana, by Parishes, 1960 . . . 26

List of Figures

Page
1. Percent Change in Population, by State, 1950-1960 . . . 6
2. Population Change in Louisiana, 1950-1960 . . . 8
3. Population Distribution, Louisiana, 1960 . . . 10
4. Population of Louisiana, by Race, 1960 . . . 16
5. Population of Louisiana, by Age-Group, 1960 . . . 18
6. Age-Sex Distribution, Louisiana Population, 1960 . . . 20
7. Population of Louisiana, by Residence, 1960 . . . 21
8. Median School Years Completed by Persons 25 Years Old and Over, Louisiana, 1960 . . . 24

Louisiana's Human Resources

Part I: Number, Distribution, and Composition of the Population, 1960

Alvin L. Bertrand

The greatest resource of any state is its people. This report presents in summary fashion the findings of the Eighteenth Decennial Census relating to the general population characteristics of Louisiana. In studying this report, the reader should keep in mind that population change is a human process and that population statistics are simply summaries of social behavior. In other words, people had to enlarge their families, move from farms to cities, migrate into or out of state, etc. for changes to be recorded. Thus population data are basic to many types of action-planning at the local, state, and national levels. These statistics have further sociological relevance in that they add to the store of knowledge concerning human behavior patterns and are useful in arriving at predictions for the future.

Number of Inhabitants and Population Growth

According to the final counts of the 1960 Decennial Census some 3,257,022 persons were living in Louisiana in April of that year. With this number of people, Louisiana ranked 20th in size among the 50 states in the nation.

In the United States as a whole, the 1960 Census reported a population of approximately 180 million. Population growth was greater in both Louisiana and the nation from 1950 to 1960 than for any other decade in their history. In a 10-year period some 28 million persons were added to the United States population and about 573,000 were added to the state's population. The average annual population growth in the United States and Louisiana in the past 10 years was about 3 million and 57,000 inhabitants a year, respectively. It is hard to realize that at current rates of growth a new person is added to the population of the nation about every 10½ seconds and the state gains almost 7 people an hour.

In the decade 1950-1960, only 16 of the 50 states grew faster than Louisiana. Texas and Florida were the only two southern states to increase their population at a more rapid rate. Texas population increased by 24.2 per cent, while Florida's population jumped a stunning 78.7 per cent. Louisiana showed a gain of 21.4 per cent in its population, and grew somewhat faster than the nation as a whole. According to the 1960 Census, the United States population was 18.5 per cent larger than in 1950. Figure 1 shows the percentage change in population of the various states from 1950 to 1960.

PERCENT CHANGE IN POPULATION, BY STATE, 1950-1960

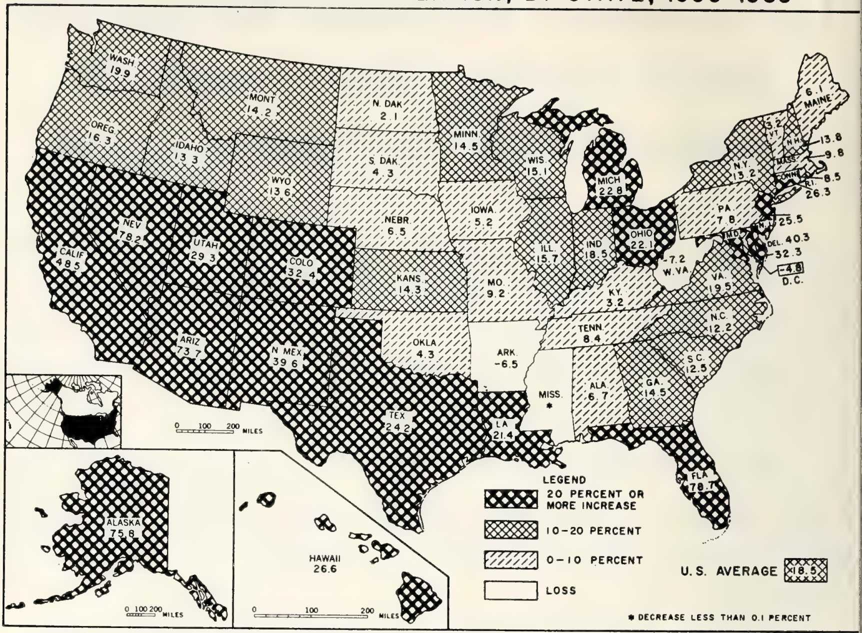


FIGURE 1

The population growth of Louisiana through the years is shown i Table 1. Data in this table indicate that the state has experienced continuous if somewhat erratic increase in population since 1810. Sig nificantly, the percentage increase in the state's population was highe from 1950 to 1960 than for any decade since the turn of the century.

It is interesting to compare the population of Louisiana with tha of its immediate neighbors. Mississippi Census counts show that stat had slightly less than two and one-fifth million people in 1960. It wa roughly two-thirds the population size of Louisiana. Furthermore, Miss issippi had a net loss of 773 persons from 1950 to 1960. The Arkansa Census counted just under two million inhabitants in 1960. That state' population decreased by well over 100,000 in the 1950-60 decade. Texas Louisiana's giant neighbor to the west, included 9.5 million person within its borders in 1960. This means there are almost three Texan for every Louisianian. Texas gained almost as many people in 10 year as are contained in the whole state of Arkansas.

Within Louisiana, the recent growth of population has taken plac principally in the southern parishes. (See Figure 2 and Table 2.) N parish south of Rapides Parish had a loss in people from 1950 to 1960 whereas all parishes in the northern part of the state, not including city or near a major city, suffered decreases in population. Concordi Parish might be considered an exception, but its population increas

TABLE 1.—Louisiana Population Growth, by Residence, 1810-1960

Year	The State		Urban		Rural	
	Total population	Per cent increase over previous census	Population	Per cent of total population	Population	Per cent of total population
1960	3,257,022	21.4	1,831,812	56.2	1,425,210	43.8
1950	2,683,516	13.5	1,379,998*	51.4*	1,303,518*	48.6*
1940	2,363,880	12.5	980,439	41.5	1,383,441	58.5
1930	2,101,593	16.9	833,532	39.7	1,268,061	60.3
1920	1,798,509	8.6	628,163	34.9	1,170,346	65.1
1910	1,656,388	19.9	496,516	30.0	1,159,872	70.0
1900	1,381,625	23.5	366,288	26.5	1,015,337	73.5
1890	1,118,588	19.0	283,845	25.4	834,743	74.6
1880	939,946	29.3	239,390	25.5	700,556	74.5
1870	726,915	2.7	202,523	27.9	524,392	72.1
1860	708,002	36.7	185,026	26.1	522,976	73.9
1850	517,762	46.9	134,470	26.0	383,292	74.0
1840	352,411	63.4	105,400	29.9	247,011	70.1
1830	215,739	40.6	46,082	21.4	169,657	78.6
1820	153,407	100.4	27,176	17.7	126,231	82.3
1810	76,556	....	17,242	22.5	59,314	77.5

*Revised since publication of 1950 reports.

can be explained in terms of an overflow from Natchez, Mississippi.

The fastest growing parish in the state was St. Bernard, which almost tripled its population in 10 years. Jefferson Parish doubled in size and Calcasieu jumped 62 per cent. St. Charles and Plaquemines parishes followed, with their population increasing by approximately three-fifths. In terms of numerical increase, the leading parish was Jefferson, which increased by more than 100,000 persons. The next four highest parishes in absolute population gains were: East Baton Rouge, which added 71,822 persons; Orleans, with a rise in population of 57,080; Calcasieu, with an addition of 55,841 people; and Caddo, with an increase of 47,312 inhabitants.

It is worthy of note that 19 parishes of the state experienced a decrease in inhabitants between 1950 and 1960. (See Figure 2.) Percentagewise, the greatest losers were: Claiborne, 23 per cent; West Carroll, 18 per cent; Red River, 18 per cent; Bienville, 12 per cent; and Caldwell, 12 per cent. Claiborne Parish had 5,656 fewer people in 1960 than in 1950. Based on absolute losses of population, the next four parishes were: West Carroll, 3,071; Richland, 2,848; Franklin, 2,688; and Bienville, 2,379.

Here, it is interesting to observe that two-thirds of the 64 parishes in the state had a net out-migration, that is, more people left than moved into the parish. However, high birth rates enabled all but 19 of these parishes to show population gains.

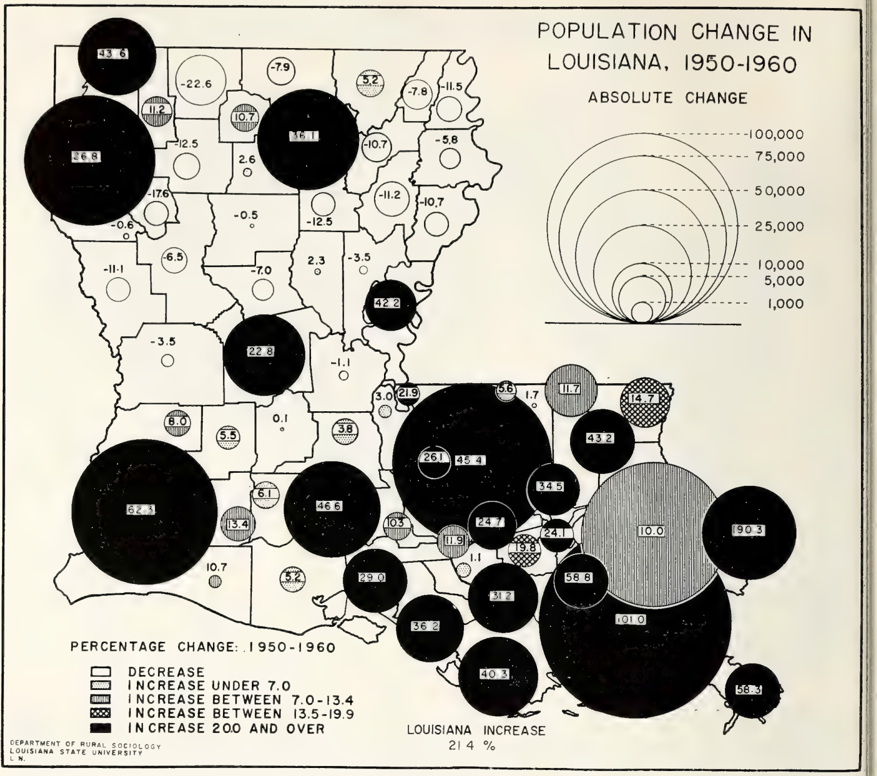


FIGURE 2

TABLE 2.—Louisiana Population Growth, by Parishes, 1950-60

Parish	1960 population	1950 population	Per cent increase or decrease 1950-1960
Louisiana	3,257,022	2,683,516	21.4
Acadia	49,931	47,050	6.1
Allen	19,867	18,835	5.5
Ascension	27,927	22,387	24.7
Assumption	17,991	17,278	4.1
Avoyelles	37,606	38,031	—1.1
Beauregard	19,191	17,766	8.0
Bienville	16,726	19,105	—12.5
Bossier	57,622	40,139	43.6
Caddo	223,859	176,547	26.8
Calcasieu	145,475	89,635	62.3
Caldwell	9,004	10,293	—12.5
Cameron	6,909	6,244	10.7
Catahoula	11,421	11,834	—3.5
Claiborne	19,407	25,063	—22.6
Concordia	20,467	14,398	42.2

(Continued)

TABLE 2. (Continued)

Parish	1960 Population	1950 Population	Per cent increase or decrease 1950-1960
De Soto	24,248	24,398	—0.6
East Baton Rouge	230,058	158,236	45.4
East Carroll	14,433	16,302	—11.5
East Feliciana	20,198	19,133	5.6
Evangeline[1]	31,639	31,629	. . . .
Franklin	26,088	29,376	—11.2
Grant	13,330	14,263	—6.5
Iberia	51,657	40,059	29.0
Iberville	29,939	26,750	11.9
Jackson	15,828	15,434	2.6
Jefferson	208,769	103,873	101.0
Jefferson Davis	29,825	26,298	13.4
Lafayette	84,656	57,743	46.6
Lafourche	55,381	42,209	31.2
LaSalle	13,011	12,717	2.3
Lincoln	28,535	25,782	10.7
Livingston	26,974	20,054	34.5
Madison	16,444	17,451	—5.8
Morehouse	33,709	32,038	5.2
Natchitoches	35,653	38,144	—6.5
Orleans	627,525	570,445	10.0
Ouachita	101,663	74,713	36.1
Plaquemines	22,545	14,239	58.3
Pointe Coupee	22,488	21,841	3.0
Rapides[1]	111,351	90,648	22.8
Red River	9,978	12,113	—17.6
Richland	23,824	26,672	—10.7
Sabine	18,564	20,880	—11.1
St. Bernard	32,186	11,087	190.3
St. Charles	21,219	13,363	58.8
St. Helena	9,162	9,013	1.7
St. James	18,369	15,334	19.8
St. John the Baptist	18,439	14,861	24.1
St. Landry	81,493	78,476	3.8
St. Martin	29,063	26,353	10.3
St. Mary	48,833	35,848	36.2
St. Tammany	38,643	26,988	43.2
Tangipahoa	59,434	53,218	11.7
Tensas	11,796	13,209	—10.7
Terrebonne	60,771	43,328	40.3
Union	17,624	19,141	—7.9
Vermilion	38,855	36,929	5.2
Vernon	18,301	18,974	—3.5
Washington	44,015	38,371	14.7
Webster	39,701	35,704	11.2
West Baton Rouge	14,796	11,738	26.1
West Carroll	14,177	17,248	—17.8
West Feliciana	12,395	10,169	21.9
Winn	16,034	16,119	—0.5

[1] Boundary changes between Evangeline and Rapides since 1950.

Distribution of the Population

The distribution of the population of Louisiana is shown in Figure 3. It can readily be seen that the majority of the inhabitants are located in the larger cities. In fact, about one-third of the people of the state live in the five largest cities. The 1960 Census disclosed that New Orleans had 627,525 people, Shreveport 164,372, Baton Rouge 152,219, Lake Charles 63,392, and Monroe 52,215. In actuality, each of the major cities included a sizeable population outside its corporate limits, which for all practical purposes made up part of the city. (See Table 3 for data on the size of cities and of the population in urbanized areas around the larger cities.)

A glance at Figure 3 indicates that the majority of the people of the state live in southern Louisiana. As a matter of fact, approximately two-thirds of the population is found in the area from Alexandria south. Outside of New Orleans the largest concentrations of people are in the Baton Rouge and the Lafayette-Opelousas population complex.

The five largest parishes in terms of numbers of people were: Or-

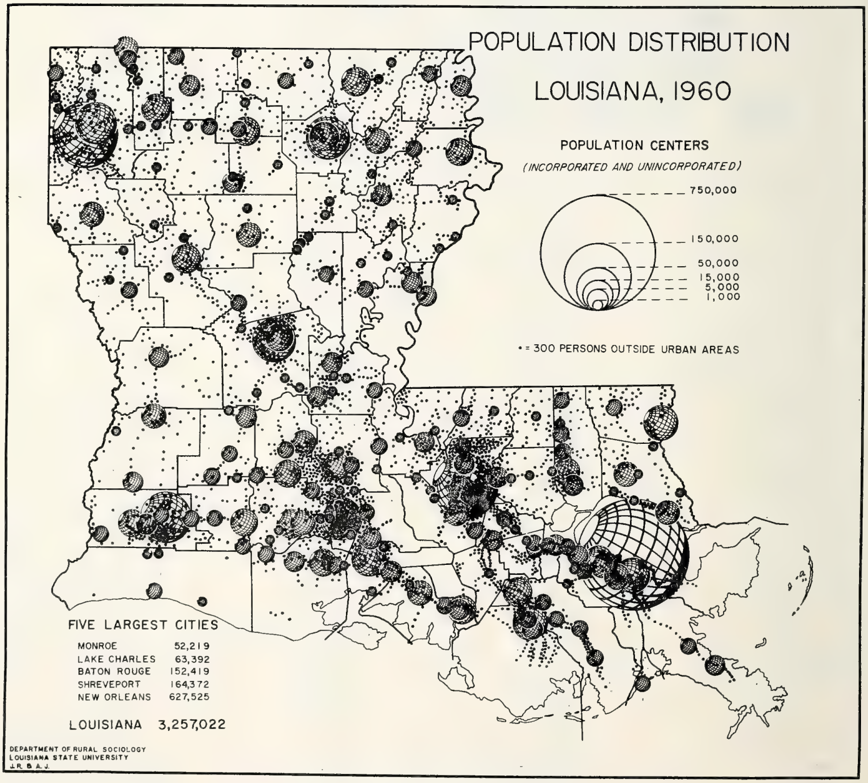


FIGURE 3

TABLE 3.—Population Growth of Incorporated Places of 10,000 or More and Urbanized Areas in Louisiana, 1950-1960

Towns, cities and urbanized areas	1960 population	1950 population	Increase over previous census	
			Number	Per cent
Abbeville	10,414	9,338	1,076	11.5
Alexandria	40,279	34,913	5,366	15.4
Bastrop	15,193	12,769	2,424	19.0
Baton Rouge	152,419	125,629	26,790	21.3
Outside central city	77,639	32,607	45,032	138.1
Total urban area	230,058	158,236	71,822	45.4
Bogalusa	21,423	17,798	3,625	20.4
Bossier City	32,776	15,470	17,306	111.9
Crowley	15,617	12,784	2,833	22.2
Eunice	11,326	8,184	3,142	38.4
Gretna	21,967	13,813	8,154	59.0
Hammond	10,563	8,010	2,553	31.9
Houma	22,561	11,505	11,056	96.1
Jennings	11,887	9,663	2,224	23.0
Kenner	17,037	5,535	11,502	207.8
Lafayette	40,400	33,541	6,859	20.4
Lake Charles	63,392	41,272	22,120	53.6
Outside central city	82,083	48,368	33,720	69.7
Total urban area	145,475	89,635	55,840	62.3
Minden	12,785	9,787	2,998	30.6
Monroe	52,219	38,572	13,647	35.4
Outside central city	49,444	36,141	13,303	36.8
Total urban area	101,663	74,713	26,950	36.1
Morgan City	13,540	9,759	3,781	38.7
Natchitoches	13,924	9,914	4,010	40.4
New Iberia	29,062	16,467	12,595	76.5
New Orleans	627,525	570,445	57,080	10.0
Outside central city	240,955	114,960	125,995	109.6
Total urban area	868,480	685,405	183,075	26.7
Opelousas	17,417	11,659	5,758	49.4
Ruston	13,991	10,372	3,619	34.9
Shreveport	164,372	127,206	37,166	29.2
Outside central city	117,109	89,480	27,629	30.9
Total urban area	281,481	216,686	64,795	29.9
Sulphur	11,429	5,996	5,433	90.6
Thibodaux	13,403	7,730	5,673	73.4
West Monroe	15,215	10,302	4,913	47.7

leans, 627,525; East Baton Rouge, 230,058; Caddo, 223,859; Jefferson, 208,769; and Calcasieu, 145,476. Of the ten largest parishes in the state only two were located in North Louisiana. At the other extreme, only three of the ten smallest parishes, population-wise, were in South Louisiana. The five smallest parishes were: Cameron, 6,909; Caldwell, 9,004; St. Helena, 9,162; Red River, 9,978; and Catahoula, 11,421.

From the above, it is clear that the redistribution of the population of the state during recent years is closely related to the urban-industrial revolution being experienced. This is dramatically portrayed by the fact that in 1960 one-half of all the people of Louisiana resided in the seven urban-industrial parishes of Caddo, Calcasieu, East Baton Rouge, Jefferson, Orleans, Ouachita, and Rapides.

Composition of the Population

The make-up or composition of a state's population tells much about its potentials and problems. Data from the 1960 Census relating to selected major characteristics are presented in succeeding paragraphs. Among the topics discussed are differentials in sex, race, residence, and age.

Sex Composition

Between 1950 and 1960 the sex ratio (number of males per 100 females) in Louisiana declined from 96.7 to 95.6. This means that in ten years there was a decrease of 1.1 males for every 100 females in the state. The same pattern held true for the United States as a whole, with the sex ratio dropping from 98.6 to 97.1. There are now something like 75,000 more females than males in the state and 3,000,000 more women than men in the nation. The total number of males counted in the state in 1960 was 1,592,254 as compared with 1,664,768 females. In both Louisiana and the nation, women out-numbered men for the first time in 1950.

Although all factors relating to the changing sex-ratios in the state and nation are not known, the change is associated principally with differential mortality. Women apparently enjoy lower mortality rates at all ages than do men.

TABLE 4.—Population Distribution According to Sex, Louisiana, by Parishes, 1960

Parish	Male		Female		Sex
	Number	Per cent	Number	Per cent	ratio
Louisiana	1,592,254	48.9	1,664,768	51.1	95.6
Acadia	24,595	49.25	25,336	50.74	97.1
Allen	9,852	49.53	10,015	50 59	98.0
Ascension	13,846	49.57	14,081	50.42	98.3
Assumption	8,945	49.72	9,046	50.28	98.9
Avoyelles	18,600	49.46	19,006	50.53	97.9
Beauregard	9,669	50.38	9,522	49.61	101.5
Bienville	8,300	49.26	8,426	50.37	98.5
Bossier	29,186	50.65	28,436	49.34	102.6
Caddo	106,233	47.45	117,626	53.54	90.3
Calcasieu	72,881	50.09	72,594	49.90	100.4
Caldwell	4,461	49.54	4,543	50.45	98.2
Cameron	3,562	51.55	3,347	48.44	106.4
Catahoula	5,635	56.35	5,786	50.66	97.4
Claiborne	9,309	47.96	10,098	52.03	92.2

(*Continued*)

TABLE 4. (Continued)

Parish	Male		Female		Sex
	Number	Per cent	Number	Per cent	ratio
Concordia	10,015	48.91	10,452	51.04	95.8
De Soto	11,623	47.93	12,625	52.06	92.1
E. Baton Rouge	112,266	48.79	117,792	51.20	95.3
East Carroll	6,961	48.22	7,472	51.77	93.2
East Feliciana	10,090	49.95	10,108	50.04	99.8
Evangeline	15,759	49.80	15,880	50.19	99.2
Franklin	12,910	49.48	13,178	50.51	98.0
Grant	6,616	49.63	6,714	50.36	98.5
Iberia	25,625	49.60	26,032	50.39	98.4
Iberville	14,785	49.38	15,154	50.61	97.6
Jackson	7,778	49.14	8,050	50.85	96.6
Jefferson	103,519	49.58	105,250	50.41	98.3
Jefferson Davis	14,763	49.49	15,062	50.50	98.0
Lafayette	41,750	49.31	42,906	50.68	97.3
Lafourche	27,669	49.96	27,712	50.03	99.8
LaSalle	6,469	49.71	6,542	50.28	98.9
Lincoln	13,978	48.98	14,557	51.01	96.0
Livingston	13,606	50.44	13,368	49.55	101.8
Madison	7,970	48.46	8,474	51.53	94.0
Morehouse	16,267	48.25	17,442	51.74	93.3
Natchitoches	17,451	48.94	18,202	51.05	95.9
Orleans	297,530	47.41	329,995	52.58	90.2
Ouachita	49,087	48.28	52,576	51.71	93.4
Plaquemines	11,561	51.27	10,984	48.72	105.2
Pointe Coupee	11,079	49.26	11,409	50.73	97.1
Rapides	54,350	48.80	57,001	51.19	95.3
Red River	4,830	48.40	5,148	51.59	93.8
Richland	11,704	49.12	12,120	50.87	91.6
Sabine	9,177	49.43	9,387	50.56	97.8
St. Bernard	16,051	49.89	16,135	50.15	99.5
St. Charles	10,596	49.93	10,623	50.06	99.7
St. Helena	4,562	49.79	4,600	50.20	99.2
St. James	8,976	48.86	9,393	51.13	95.6
St. John the Baptist	9,233	50.07	9,206	49.92	100.3
St. Landry	39,895	48.95	41,598	51.04	95.9
St. Martin	14,333	49.31	14,730	50.68	97.3
St. Mary	24,262	49.68	24,571	50.31	98.7
St. Tammany	19,121	49.48	19,522	50.51	97.9
Tangipahoa	29,379	49.43	30,055	50.56	97.7
Tensas	5.609	47.55	6,187	52.44	90.6
Terrebonne	30,475	50.14	30,296	49.85	100.7
Union	8,675	49.22	8,949	50.77	96.9
Vermilion	19,126	49.22	19,729	50.77	96.9
Vernon	9,019	49.28	9,282	50.71	97.2
Washington	21,448	48.81	22,567	51.27	95.0
Webster	19,368	48.78	20,333	51.21	95.2
W. Baton Rouge	7,193	48.61	7,603	51.38	94.6
West Carroll	6,979	49.22	7,198	50.77	96.9
West Feliciana	7,724	62.31	4,671	37.68	165.4
Winn	7,968	49.69	8,066	50.30	98.8

Table 4 includes the number of each sex group in each parish. These tabulations show that the urban parishes have the highest percentages of females in their population. This is a traditional pattern, brought about by the selective migration of females from rural areas.

It is of interest to note that the non-white sex ratio (92.4) is lower than that of the whites (97.2) in the state. Apparently the shortage of Negro men is related to their tendency to migrate from the state in larger relative numbers than Negro women. Negro men also die at an earlier age than Negro women. The low Negro sex-ratio helps explain why the sex-ratio of the state is lower than that for the nation.

Color Composition

The color or racial composition of the population of the state is somewhat unique in the United States. Approximately 32 per cent of the state's population was classified as non-white in 1960, a drop of one percentage point from 1950. Altogether there were 1,045,307 non-whites, including 1,039,207 Negroes and 6,100 members of other races. Of the latter, 3,587 were Indian, 519 were Japanese, 731 were Chinese, 754 were Filipino, and 509 were Koreans, Asian Indians, or Malayans.

Only two states, Mississippi (42.3) and South Carolina (34.9), had a higher percentage of non-whites in their population in 1960 than Louisiana. Only six states recorded more than a million Negroes, and Louisiana was one of them. The year 1960 was the first census year in which more than a million non-whites were counted in the state.

Table 5 and Figure 4 show the distribution of non-whites in the state. Study of this chart and table shows that non-whites are heavily concentrated in the Mississippi and Red River Delta areas of Louisiana.

TABLE 5.—Population Distribution According to Race, Louisiana, by Parishes, 1960

Parish	White		Non-white	
	Number	Per cent	Number	Per cent
Louisiana	2,211,715	67.9	1,045,307	32.1
Acadia	40,104	80.3	9,827	19.7
Allen	14,934	75.2	4,933	24.8
Ascension	19,013	68.1	8,914	31.9
Assumption	10,573	58.8	7,418	41.2
Avoyelles	27,134	72.2	10,472	27.8
Beauregard	14,886	77.6	4,305	22.4
Bienville	8,470	50.6	8,256	49.4
Bossier	43,276	75.1	14,346	24.9
Caddo	142,203	63.5	81,656	36.5
Calcasieu	115,100	79.1	30,375	20.9
Caldwell	6,499	72.2	2,505	27.8
Cameron	6,470	93.6	439	6.4
Catahoula	7,405	64.8	4,016	35.2
Claiborne	9,646	49.7	9,761	50.3

(Continued)

TABLE 5. (Continued)

Parish	White		Non-white	
	Number	Per cent	Number	Per cent
Concordia	10,993	53.7	9,474	46.3
De Soto	10,294	42.5	13,954	57.5
E. Baton Rouge	156,895	68.2	73,163	31.8
East Carroll	5,602	38.8	8,831	61.2
East Feliciana	9,284	46.0	10,914	54.0
Evangeline	23,158	73.2	8,481	26.8
Franklin	15,497	59.4	10,591	40.6
Grant	10,106	75.8	3,224	24.2
Iberia	36,843	71.3	14,814	28.7
Iberville	15,272	51.0	14,667	49.0
Jackson	10,696	67.6	5,132	32.4
Jefferson	176,845	84.7	31,924	15.3
Jefferson Davis	23,491	78.8	6,334	21.2
Lafayette	64,323	76.0	20,333	24.0
Lafourche	48,619	87.8	6,762	12.2
LaSalle	11,355	87.3	1,656	12.7
Lincoln	16,594	58.2	11,941	41.8
Livingston	22,921	85.0	4,053	15.0
Madison	5,767	35.1	10,677	64.9
Morehouse	17,911	53.1	15,798	46.9
Natchitoches	20,082	56.3	15,571	43.7
Orleans	392,594	62.6	234,931	37.4
Ouachita	68,904	67.8	32,759	32.2
Plaquemines	16,041	71.2	6,504	28.8
Pointe Coupee	10,434	46.4	12,054	53.6
Rapides	77,345	69.5	34,006	30.5
Red River	5,232	52.4	4,746	47.6
Richland	13,255	55.6	10,569	44.4
Sabine	14,181	76.4	4,383	23.6
St. Bernard	29,761	92.5	2,425	7.5
St. Charles	15,474	72.9	5,745	27.1
St. Helena	4,076	44.5	5,086	55.5
St. James	9,315	50.7	9,054	49.3
St. John the Baptist	8,926	48.4	9,513	51.6
St. Landry	46,443	57.0	35,050	43.0
St. Martin	18,242	62.8	10,821	37.2
St. Mary	33,755	60.1	15,078	30.9
St. Tammany	28,031	72.5	10,612	27.5
Tangipahoa	39,315	66.1	20,119	33.9
Tensas	4,128	35.0	7,668	65.0
Terrebonne	48,328	79.5	12,443	20.5
Union	11,139	63.2	6,485	36.8
Vermilion	33,836	87.1	5,019	12.9
Vernon	15,858	86.7	2,443	13.3
Washington	29,107	66.1	14,908	33.9
Webster	26,006	65.5	13,695	34.5
W. Baton Rouge	7,502	50.7	7,294	49.3
West Carroll	10,998	77.6	3,179	22.4
West Feliciana	4,197	33.9	8,198	66.1
Winn	11,031	68.8	5,003	31.2

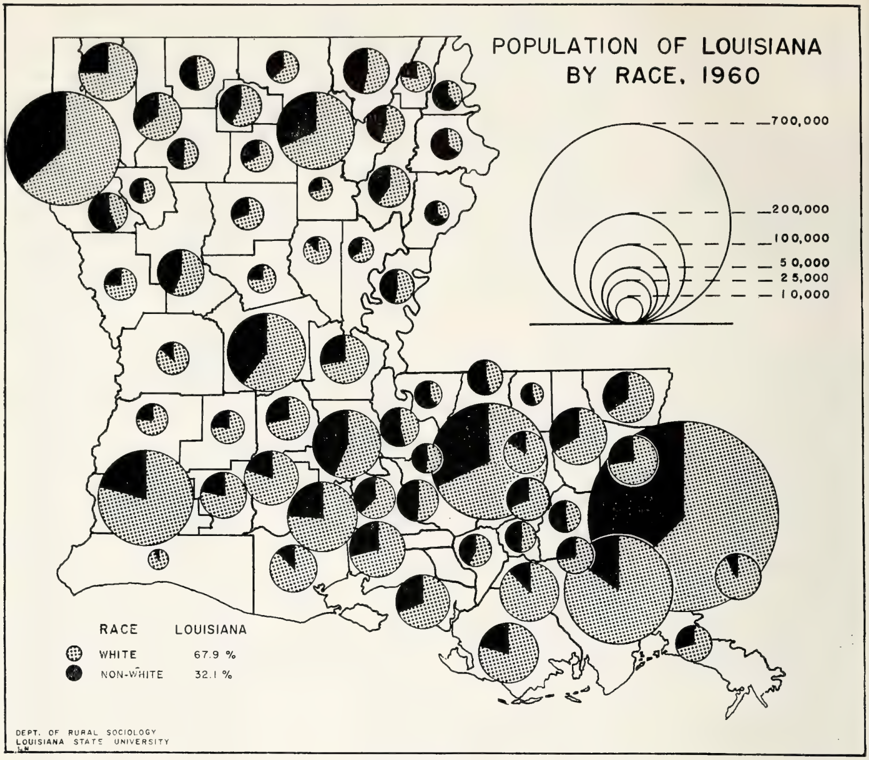


FIGURE 4

The five parishes with the highest percentages of non-whites were: West Feliciana, 66 per cent; Tensas, 65 per cent; Madison, 65 per cent; West Carroll, 61 per cent; and DeSoto, 58 per cent. As might be expected, Orleans contained the largest number of non-whites of any parish, 234,931, but these represented only 37 per cent of the parish total.

Parishes with the least number of non-whites are generally found along the Gulf Coast. The five parishes with the lowest percentages of persons in this category were: Cameron, 6 per cent; St. Bernard, 8 per cent; Lafourche, 12 per cent; LaSalle, 13 per cent; and Vermilion, 13 per cent.

In years past, the non-whites of the state were overwhelmingly rural in residence, most of them working on farms. This is no longer true. As many as three out of five non-whites (61.7 per cent) live in urban places. Only about a third of the non-whites remain on farms or in rural areas.

Many persons pose questions regarding the relative growth of the white and non-white populations of the state. From 1950 to 1960, whites in the state increased by 23 per cent. In contrast, non-whites increased by only 18 per cent. One should be cautious in interpreting these data however. The difference is not in the birth rate but in migration patterns.

Negroes continue to have the higher birth rate, but move out of the state in larger relative numbers. There was actually a net out-migration of non-whites at the same time that their total numbers increased. The difference is accounted for by births in this group. This point is amply illustrated by the fact that, nationally, Negroes increased by 25 per cent, some 40 per cent higher than the average national rate of population increase. The increase of the Negro population in the United States as a whole is due to reduced mortality rates coupled with a continued high fertility rate.

As an aside, it is of interest to note that each of the southern states had a net out-migration of non-whites. Taken together, 1.5 million more non-whites left than came into these states. The movement of non-whites from Mississippi alone totalled 300,000 individuals.

Age Composition

The age composition of a state's population has significance in terms of school and welfare needs, among other things. This is true because persons below 18 years of age and over 65 years are in the so-called dependent ages, and are likely to need services and care which they cannot provide for themselves.

The age composition of a population is closely tied to its birth rate. In 1960, as many as two-fifths of the people of Louisiana were under 18 years of age. Some seven per cent of the state's people were at least 65 years of age. (See Figure 5 and Table 6.) When put together, these two percentages add to an interesting fact—close to half of the people of the state are outside of the "productive" ages. For those who have a query as to why there are so many persons in the"dependent" ages, an answer may be found in two developments. First, the birth rate within the state remains quite high. In 1960, there were 562 children under five years of age for every 1,000 women 15 to 49 years old. In the United States as a whole there were only 488 children under five for every 1,000 women 15 to 49 years of age. The second development is increasing longevity. The average life expectancy of inhabitants of the nation has risen considerably within recent years, reaching an all-time high of 69.7 years in 1959.[1]

In 1960, the median age of the people of the state was 25.3 years. This means that exactly half of the people were less than this age and half over. By way of comparison, the median age of the United States population was 29.5 years. The state thus had a relatively young population. The median age of males in Louisiana was lower—24.4 years—as compared with that of females—26.2 years. In the nation, white females have a life expectancy of 73.9 years at birth, as compared with 67.3 years for white males. Negro females have a life expectancy of 66.2 years as compared with 60.9 years for Negro males.[2]

---

[1] *Statistical Bulletin,* Metropolitan Life Insurance Co., Volume 42, August, 1961, p. 6.
[2] *Ibid*, p. 7.

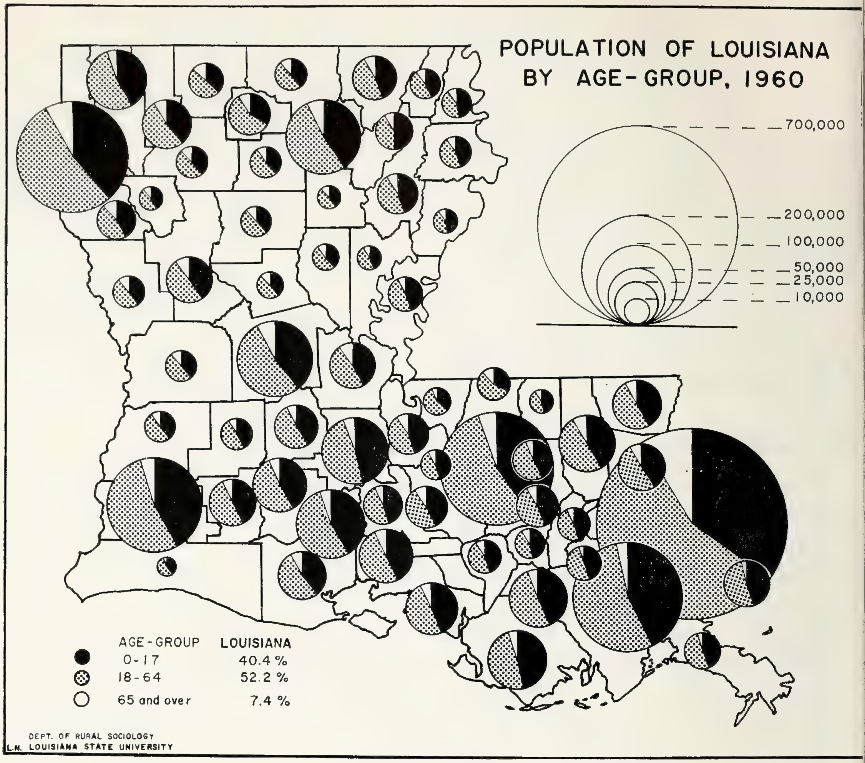


FIGURE 5

TABLE 6.—Population Distribution According to Selected Age-Groups, Louisiana, by Parishes, 1960

Parish	Total population	Per cent under 18 years	Per cent 18 to 64 years	Per cent 65 years and over	Median age
Louisiana	3,257,022	40.4	52.2	7.4	25.3
Acadia	49,931	41.9	51.0	7.2	24.3
Allen	19,867	42.5	49.2	8.3	24.3
Ascension	27,927	44.8	47.5	7.8	21.9
Assumption	17,991	44.8	46.5	8.7	21.8
Avoyelles	37,606	41.7	48.9	9.4	25.8
Beauregard	19,919	39.5	50.2	10.3	26.6
Bienville	16,726	38.3	49.0	12.7	29.7
Bossier	57,622	42.0	53.2	4.8	22.7
Caddo	223,859	38.6	53.3	8.1	27.4
Calcasieu	145,475	42.0	53.5	4.6	23.2
Caldwell	9,004	40.9	46.9	12.2	27.9
Cameron	6,909	40.1	53.9	6.0	25.6
Catahoula	11,421	43.5	47.1	9.4	23.7
Claiborne	19,407	37.3	49.6	13.1	31.1

(Continued)

TABLE 6. (Continued)

Parish	Total population	Per cent under 18 years	Per cent 18 to 64 years	Per cent 65 years and over	Median age
Concordia	20,467	45.0	47.5	7.5	22.5
De Soto	24,248	41.3	46.4	12.3	26.4
E. Baton Rouge	230,058	40.2	54.6	5.2	23.8
East Carroll	14,433	46.7	43.1	10.1	20.8
East Feliciana	20,198	31.5	56.6	11.9	34.9
Evangeline	31,639	42.3	50.7	7.0	24.5
Franklin	26,088	44.7	46.2	9.1	22.6
Grant	13,330	39.3	48.2	12.4	29.3
Iberia	51,657	43.0	50.3	6.7	23.3
Iberville	29,939	43.2	48.0	8.9	23.5
Jackson	15,828	38.0	51.9	10.0	28.8
Jefferson	208,769	42.7	53.3	4.0	24.9
Jefferson Davis	29,825	43.3	49.5	7.2	23.7
Lafayette	84,656	41.2	53.7	5.1	23.1
Lafourche	55,381	43.6	50.8	5.6	22.5
La Salle	13,011	37.7	52.6	9.7	29.7
Lincoln	28,535	33.0	58.3	8.6	23.1
Livingston	26,974	43.6	49.6	6.7	23.0
Madison	16,444	44.7	45.1	10.2	23.2
Morehouse	33,709	44.5	47.2	8.3	23.0
Natchitoches	35,653	39.9	50.0	10.1	23.3
Orleans	627,525	34.9	56.5	8.6	30.2
Ouachita	101,663	40.1	52.4	7.6	25.5
Plaquemines	22,545	44.8	51.1	4.1	21.7
Pointe Coupee	22,488	45.4	45.6	9.0	21.5
Rapides	111,351	39.3	52.7	7.9	25.9
Red River	9,978	41.2	47.3	11.5	26.8
Richland	23,824	44.9	46.4	8.6	22.4
Sabine	18,564	40.1	48.1	11.8	28.2
St. Bernard	32,186	44.5	52.0	3.5	23.6
St. Charles	21,219	45.9	48.8	5.3	21.5
St. Helena	9,162	47.1	44.1	8.8	19.9
St. James	18,369	47.4	44.7	8.0	19.8
St. John the Baptist	18,439	45.4	47.7	6.9	21.4
St. Landry	81,493	45.8	47.9	6.3	20.9
St. Martin	29,063	45.6	47.8	6.6	20.9
St. Mary	48,833	44.2	49.4	6.3	22.2
St. Tammany	38,643	41.8	50.0	8.2	25.1
Tangipahoa	59,434	41.7	50.1	8.2	23.9
Tensas	11,796	47.4	42.3	10.2	20.2
Terrebonne	60,771	46.5	48.6	4.9	20.4
Union	17,624	39.5	48.9	11.6	28.2
Vermilion	38,855	39.2	52.8	8.0	27.1
Vernon	18,301	39.1	49.5	11.3	29.5
Washington	44,015	42.7	49.5	7.8	24.4
Webster	39,701	39.0	52.1	8.9	27.6
W. Baton Rouge	14,796	45.5	47.1	7.4	21.5
West Carroll	14,177	43.3	46.9	9.8	24.9
West Feliciana	12,395	35.3	58.6	6.1	26.1
Winn	16,034	38.0	50.2	11.8	30.5

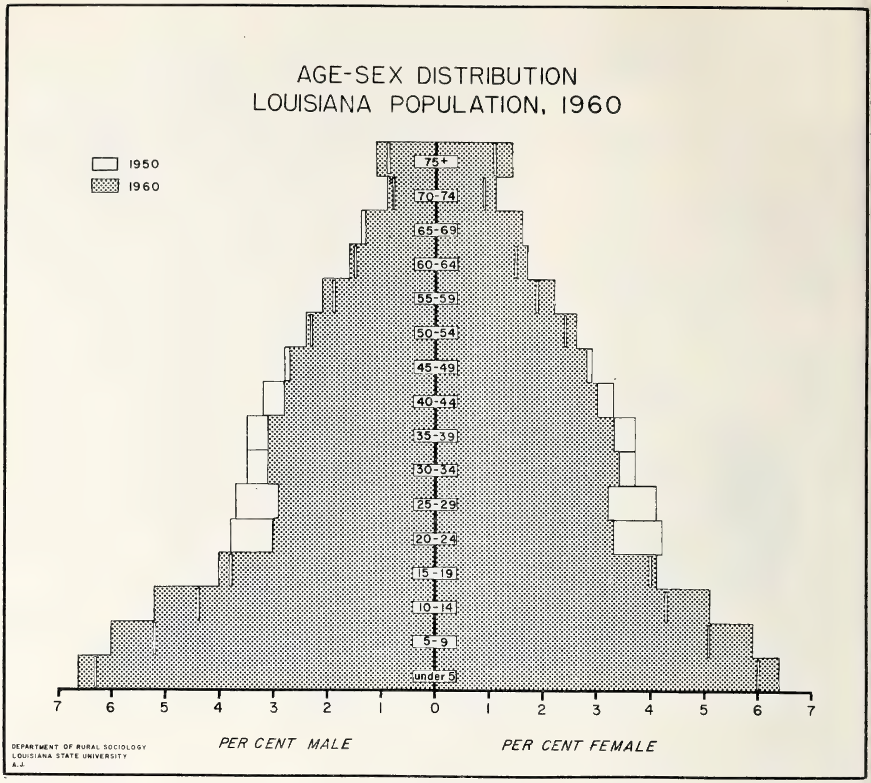


FIGURE 6

The percentage of the population in the various age groups may be seen in the population pyramid identified as Figure 6. Comparison of the change in age distribution from 1950 to 1960 clearly shows that the birth rate has increased within recent years. This is also evidenced by the fact that the median age of the population of the state was 26.7 in 1950, some 1.4 years higher than in 1960.

Residence Composition

Just 20 years ago, Louisiana was basically a rural state. In 1940, three out of every five inhabitants of the state lived outside urban places. Today, 1960, the situation is reversed. Over three-fifths (63.3 per cent) of the people in the state live in cities, towns, or urbanized areas. The remainder, just over one-third, are classed as rural in residence.

Traditionally, Louisiana, along with the rest of the southern states, has been much more rural than the United States as a whole. This picture is rapidly changing, although Louisiana is still less urban than the nation. The 1960 Census reported 70 per cent of the people of the United States as living in urban places. In this context, it is enlighten-

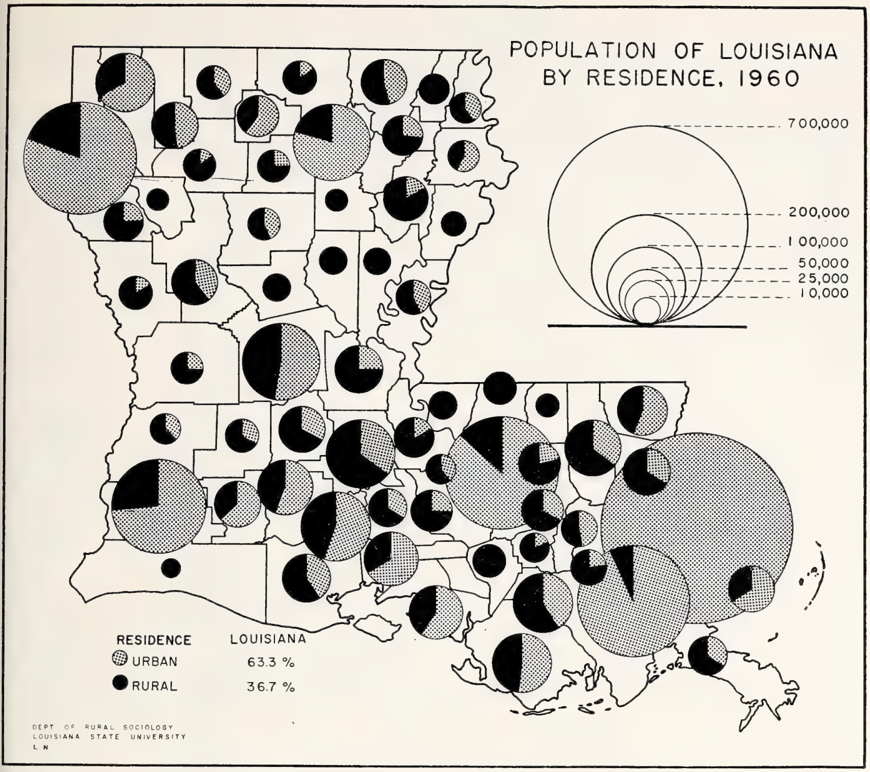


FIGURE 7

ing to note that in 39 of the 50 states the urban population comprised more than one-half of the total state population.

With the exception of the District of Columbia, which was completely urban, New Jersey was the most urban state in 1960. Nine out of ten of its inhabitants lived in towns, cities, or urbanized areas. North Dakota was the most rural of the 50 states, with almost two of every three of its inhabitants living outside of urban locations. In only 11 states were there more rural than urban inhabitants, and two of these bordered Louisiana. Both Mississippi and Arkansas were classed as predominantly rural states, with only two-fifths of their people reported as urban dwellers.

In Louisiana, as may be seen in Figure 7, the most urban parishes were those where the major cities are located. Exclusive of Orleans, which is 100 per cent urban, these were: Jefferson, 94 per cent urban; East Baton Rouge, 85 per cent urban; Caddo, 81 per cent urban; Ouachita, 79 per cent urban; and Calcasieu, 74 per cent urban. By contrast, the state included 12 parishes without a single urban resident, although some persons in these parishes lived in places of less than 2,500 people. These parishes were Assumption, Caldwell, Cameron, Catahoula, East Feliciana,

TABLE 7.—Population Distribution According to Residence, Louisiana, by Parishes, 1960

Parish	Urban		Rural	
	Number	Per cent	Number	Per cent
Louisiana	2,060,606	63.3	1,196,416	36.7
Acadia	27,857	55.8	22,074	44.2
Allen	6,618	33.3	13,249	66.7
Ascension	9,334	33.4	18,593	66.6
Assumption	...	....	17,991	100.0
Avoyelles	9,445	25.1	28,161	74.9
Beauregard	7,188	37.5	12,003	62.5
Bienville	2,547	15.2	14,179	84.8
Bossier	38,005	66.0	19,617	34.0
Caddo	180,903	80.8	42,956	19.2
Calcasieu	107,459	73.9	38,016	26.1
Caldwell	......	....	9,004	100.0
Cameron	......	....	6,909	100.0
Catahoula	......	....	11,421	100.0
Claiborne	7,696	39.7	11,711	61.3
Concordia	8,876	43.4	11,591	56.6
De Soto	5,839	24.1	18,409	75.9
E. Baton Rouge	195,780	85.1	34,278	14.9
East Carroll	5,781	40.1	8,652	59.9
East Feliciana	....	....	20,198	100.0
Evangeline	10,440	33.0	21,199	64.0
Franklin	4,437	17.0	21,651	83.0
Grant	....	....	13,330	100.0
Iberia	34,630	67.0	17,027	33.0
Iberville	7,689	25.7	22,250	74.3
Jackson	3,848	24.3	11,980	75.7
Jefferson	196,458	94.1	12,311	5.9
Jefferson Davis	18,760	62.9	11,065	37.1
Lafayette	47,082	55.6	37,574	44.4
Lafourche	22,962	41.5	32,419	58.5
La Salle	......	....	13,011	100.0
Lincoln	17,135	60.0	11,400	40.1
Livingston	5,991	22.2	20,983	77.8
Madison	9,413	57.2	7,031	42.8
Morehouse	15,193	45.1	18,516	54.9
Natchitoches	13,924	39.1	21,729	60.9
Orleans	627,525	100.0	......	....
Ouachita	80,546	79.2	21,117	20.8
Plaquemines	7,776	34.5	14,769	65.5
Pointe Coupee	3,965	17.6	18,523	82.4
Rapides	58,532	52.6	52,819	47.4
Red River	......	....	9,978	100.0
Richland	6,566	27.6	17,258	72.4
Sabine	3,164	17.0	15,400	83.0
St. Bernard	21,254	66.0	10,932	34.0
St. Charles	4,682	22.1	16,537	77.9
St. Helena	....	....	9,162	100.0
St. James	3,274	17.8	15,095	82.2

(*Continued*)

TABLE 7. (Continued)

Parish	Urban		Rural	
	Number	Per cent	Number	Per cent
St. John the Baptist	8,838	47.9	9,601	52.1
St. Landry	28,743	35.3	52,750	64.7
St. Martin	9,771	33.6	19,292	66.4
St. Mary	29,016	59.4	19,817	40.6
St. Tammany	13,110	33.9	25,533	66.1
Tangipahoa	21,213	35.7	38,221	64.3
Tensas	......	....	11,796	100.0
Terrebonne	31,640	52.1	29,131	47.9
Union	2,727	15.5	14,897	84.5
Vermilion	15,681	40.4	23,174	59.6
Vernon	4,689	25.6	13,612	74.4
Washington	24,564	55.8	19,451	44.2
Webster	19,222	48.4	20,479	51.6
W. Baton Rouge	5,796	39.2	9,000	60.8
West Carroll	......	....	14,177	100.0
West Feliciana	......	....	12,395	100.0
Winn	7,022	43.8	9,012	56.2

Grant, LaSalle, Red River, St. Helena, Tensas, West Carroll, and West Feliciana.

In 46 parishes, at least half of the population was classified as rural. (See Table 7.)

Selected General Social and Economic Characteristics of the Population

Educational Attainment

Citizens of Louisiana have long had to face the fact that the educational status of the state's population was comparatively low. It is thus encouraging to discover that the median number of school years completed by the adult population of the state (persons 25 years of age and over) jumped from 7.7 years in 1950 to 8.8 years in 1960. Should this rate of increase continue, the state will show well among the 50 states in the decades ahead.

The median number of years of schooling completed by adult Louisianians (25 years of age and over) in the various population classes in the state are as follows:

Residence classes: urban, 9.8; rural, 7.5 (rural non-farm, 7.6; rural farm, 6.8).

Color classes: white, 10.5; non-white, 6.0.

Sex classes: males, 8.6; females, 9.0.

Approximately one-fourth of all Louisianians, 868,969 children and

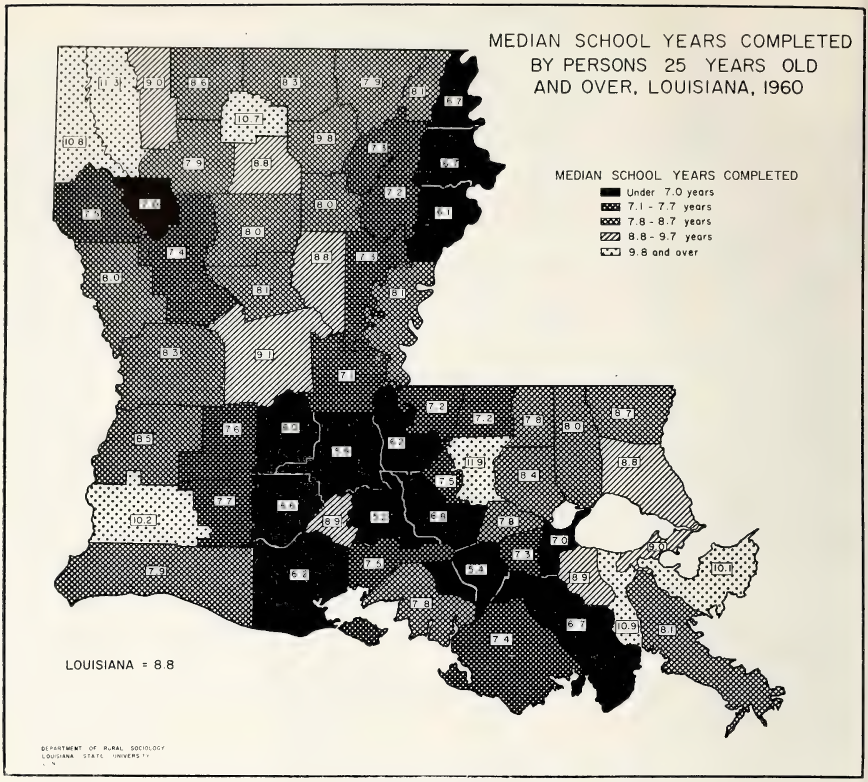


FIGURE 8

adults, were enrolled in some kind of educational institution in 1960. Of those persons 5 to 24 years of age, 71.0 per cent were enrolled in school. This represents a jump of almost 10 percentage points in 10 years.

The percentage of the state's adult population with no schooling at all dropped from 12.9 per cent in 1940 and 9.4 per cent in 1950 to 6.6 per cent in 1960. At the same time the percentage of college graduates jumped from 3.5 per cent in 1940 and 4.8 per cent in 1950 to 6.7 per cent in 1960. As many as 18.9 per cent of all persons 25 years old and over had completed four years of high school.

The highest levels of education continue to be in the urban or urban influenced parishes of the state. East Baton Rouge Parish leads all others in this respect, with adults residing in the parish having completed a median of 11.9 years of schooling. South Louisiana parishes continue to show lower levels of educational attainment, with Mississippi Delta parishes not far behind. (See Figure 8.)

Income Level

The median income of the 771,252 families counted in the state in 1960 was $4,272 for the preceding year, 1959. This amount is almost double the median income of Louisiana families in 1949, some $2,140, and testifies to the social and economic progress of the state. Individuals 14 years of age and over in 1960 with income earned a median income of $1,967 in 1959. The median income for this group was only $1,259 in 1949. Median incomes for the individuals 14 years and over making up the various classes of the population were as follows in 1959:

Residence classes: urban, $2,289; rural, $1,368 (rural non-farm, $1,455; rural farm, $1,019).

Color classes: whites, $2,799; non-whites, $1,001.

Sex classes: males, $3,042; females, $948.

Table 8 shows the median income of families by parish. Families in parishes bordering Orleans Parish and in the other urban parishes generally reported higher incomes.

Fertility Rates

Birth rates are all-important in terms of the growth of a population. The fertility ratio (number of children ever born per 1,000 women 15 to 44 years old) is one of the best measures of births. In 1960 the fertility ratio for the state was 2,032. This ratio is significantly higher than the fertility ratio of 1,618 registered in 1950. The acceleration of births in the state in the last 20 years becomes apparent when one notes that the fertility ratio in 1940 was only 1,478. The segments of the population with the highest birth rates are evident in the comparisons of fertility ratios below:

Residence classes: urban, 1,865; rural, 2,365 (rural non-farm, 2,334; rural farm, 2,508).

Color classes: white, 1,881; non-white, 2,377.

Table 8 shows the fertility ratio of each parish in the state. Study of this table indicates that the higher birth rates are found in rural parishes generally and in certain south Louisiana parishes. Parishes with low birth rates are more likely to be urban in character.

Employment Status

The state included some 2,164,411 persons 14 years old and over in 1960. Of this number just over one-half (50.5 per cent) were in the labor force. The data collected indicate that 72.9 per cent of the 1,037,354 males 14 years old and over were in the labor force and that 29.8 per cent of the 1,127,057 females in this age group were working or available for work outside their homes. It is of interest that 54.7 per cent of the women in the labor force are married and 18.2 per cent have children under six years of age.

TABLE 8.—Population Distribution According to Education, Family Income, and Fertility Rate, Louisiana, by Parishes, 1960

Parish	Median school years completed by persons 25 years old and over	Median annual income of families (1959) (Dollars)	Cumulative fertility rate*
Louisiana	8.8	4,272	2,032
Acadia	6.6	3,128	2,163
Allen	7.6	3,335	2,368
Ascension	7.8	3,877	2,274
Assumption	5.4	2,817	2,453
Avoyelles	7.1	2,159	2,406
Beauregard	8.5	3,148	2,166
Bienville	7.9	2,586	2,229
Bossier	11.3	4,568	1,980
Caddo	10.8	4,964	1,893
Calcasieu	10.2	5,167	2,046
Caldwell	8.0	2,430	2,510
Cameron	7.9	4,466	2,235
Catahoula	7.3	2,103	2,280
Claiborne	8.6	2,868	2,188
Concordia	8.1	3,266	2,354
De Soto	7.5	2,680	2,237
East Baton Rouge	11.9	5,830	1,769
East Carroll	6.7	2,065	2,663
East Feliciana	7.2	2,749	2,079
Evangeline	6.0	2,149	2,350
Franklin	7.2	2,094	2,547
Grant	8.1	2,701	2,292
Iberia	7.5	4,329	2,242
Iberville	6.8	3,125	2,380
Jackson	8.8	3,683	2,007
Jefferson	10.9	6,061	2,044
Jefferson Davis	7.7	3,795	2,379
Lafayette	8.9	4,483	1,902
Lafourche	6.7	4,330	2,190
La Salle	8.8	3,433	2,031
Lincoln	10.7	3,477	1,317
Livingston	8.4	3,825	2,321
Madison	6.7	2,190	2,621
Morehouse	7.9	3,248	2,357
Natchitoches	7.4	2,382	1,975
Orleans	9.0	4,807	1,704
Ouachita	9.8	4,367	1,998
Plaquemines	8.1	5,127	2,356
Point Coupee	6.2	2,486	2,396
Rapides	9.1	3,783	2,001
Red River	7.0	2,034	2,569
Richland	7.3	2,286	2,518
Sabine	8.0	2,816	2,362
St. Bernard	10.1	6,028	2,154
St. Charles	8.9	5,289	2,414
St. Helena	7.8	2,111	2,661

(Continued)

TABLE 8 (Continued)

Parish	Median school years completed by persons 25 years old and over	Median annual income of families (1959) (Dollars)	Cumulative fertility rate*
St. James	7.3	3,659	2,538
St. John the Baptist	7.0	4,079	2,284
St. Landry	5.9	2,480	2,415
St. Martin	5.2	2,518	2,359
St. Mary	7.8	4,686	2,272
St. Tammany	8.8	3,868	2,182
Tangipahoa	8.0	2,917	2,188
Tensas	6.1	1,683	2,560
Terrebonne	7.4	4,831	2,387
Union	8.3	2,890	2,218
Vermilion	6.2	3,354	2,140
Vernon	8.3	2,788	2,298
Washington	8.7	3,924	2,291
Webster	9.0	4,055	2,023
West Baton Rouge	7.5	4,037	2,288
West Carroll	8.1	2,155	2,619
West Feliciana	7.2	2,459	2,472
Winn	8.0	2,777	2,203

*Children ever born per 1,000 women 15 to 44 years old of all marital classes.

Summary and Implications of Population Changes

The recent changes in the population of the state are summarized briefly below. The implications which these trends have for the future of the state are not always readily seen. However, certain ramifications are so obvious as to make clear the nature of problems to be faced.

1. The total population of the state is increasing at a relatively rapid rate. However, the rate is not the same for all regions. This phenomenon has at least two important implications for planners. First, the state must anticipate the services which an expanding population will need and demand. The exact nature of these services is more apparent when one studies the composition and specific characteristics of the population. Secondly, the state cannot but be destined for an increasingly important role in regional and national affairs. This prospect presents a great challenge to present and future state leaders.

When contemplating the population growth of the state, one must pay especial heed to varying trends within the state proper. Thinking of the state as a whole, one may speak of expanding industry, school systems, etc. However, in certain areas of the state, as previously pointed out, the problem is one of adjusting to a decreasing population. Problems related to empty schools, low income, and poorly supported churches and other social institutions will need careful study and attention in substantial areas of the state.

2. The rapid growth of the population has taken place in the urban

areas of the state, while the rural population has generally declined. Why this is true is rather obvious, but the implications for the future of the state may not be as easy to see. The technological revolution which has characterized agriculture within recent years has meant that fewer hands are needed in the fields. At the same time, a steady trend toward industrialization has provided opportunity for an increasing number of workes in the city.

Perhaps the most important implication of this trend is in terms of the future voting behavior of the populace. Studies through the years have clearly shown that urban and rural peoples vote somewhat differently on certain issues. One can also expect a gradual change in the prevailing attitudes, values, and goals of people as urbanization continues. State services and facilities will also have to be increasingly oriented toward the needs of an urban populace.

3. The state continues to have one of the largest non-white populations of any state, although this population has not increased as fast as the white population in the last decade. Non-whites continue to have a high birth rate, but have a net migration out of the state. The fact that Negroes are moving from farms to cities will probably mean the taking on of a more urban character by this racial group.

4. The population of the state continues to be increasingly dominated by females. This finding leads to all kinds of speculations, but one development may be clearly anticipated. Women will assume an increasingly important place in the political and business affairs of the state.

5. The people of the state are relatively young, compared to those of the nation as a whole. This fact is accounted for principally by the high birth rate which persists in the state. The high ratio of children to adults means a high per capita cost for persons in the productive ages for education and other services. However, it also means that the state's population is a young and vigorous one.

6. The educational and income levels of the state have risen in the past 10 years but remain relatively low, when compared to those of the other states of the nation.

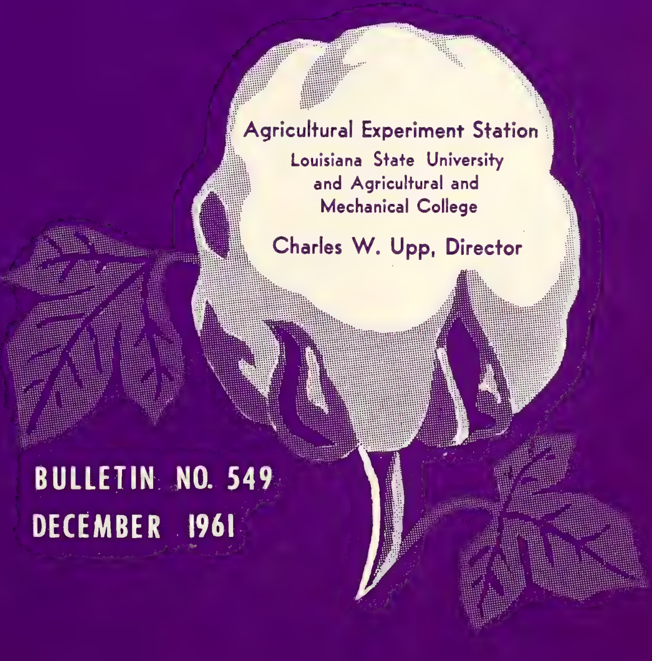
7. The birth rates within the state are relatively high and continue to increase.

In conclusion, the 1960 Decennial Census has shown that the population of the state is adjusting to the urban-industrial revolution which has been taking place within its borders for some time. Along with its blessings and anticipated consequences, this revolution has brought many unanticipated consequences and generated serious problems and challenges. The future of the state will depend on how quickly and effectively social adjustments to these changing conditions can be worked out.

OUISIANA COTTON QUALITY STATISTICS

AND RELATED DATA

JAMES HUDSON



Agricultural Experiment Station
Louisiana State University
and Agricultural and
Mechanical College

Charles W. Upp, Director

BULLETIN NO. 549
DECEMBER 1961

TABLE OF CONTENTS

Page
Summary 4
Introducton 4
Purpose 5
Source of Data 5
Production Areas, Soil and Climate 7
Method of Harvest 9
Gin Equipment 12
Markets and Facilities 13
Varieties Planted 14
Grade, Staple and Preparation 14
Fiber and Spinning Tests Results 16

FIGURES

Page
Figure 1. Cotton Quality Reporting Districts, Louisiana 6
Figure 2. Planted Acreage and Production of Cotton by Parishes, Louisiana, 1959 7
Figure 3. General Soil Areas or Associations of Louisiana 8
Figure 4. Climate of Louisiana 10-11
Figure 5. Method of Harvesting Cotton, Louisiana, 1949-60 12
Figure 6. Location of Cotton Market Centers, Louisiana 13
Figure 7. Proportion of Cotton Grading Middling White and Better, and Spotted, Louisiana, 1928-59 14
Figure 8. Proportion of Cotton With Staple Length Longer Than One Inch, Longer Than One and One-Sixteenth Inches, and Percentage of Rough Preparation, Louisiana, 1928-59 15

TABLES

Page
Table 1. Method of Harvesting Cotton in Louisiana, 1949-50 to 1960-61 9
Table 2. Cotton Gin Equipment, Louisiana, 1957, 1959 and 1961 . 17
Table 3. Estimated Percentage of Cotton Acreage Planted to Specified Varieties, by Districts, Louisiana, 1950-1961 .. 18
Table 4. Estimated Percentage of Cotton Acreage Planted to Specified Varieties by Parishes and Districts, 1955-1961 . 20
Table 5. Proportion of White and Extra White Cotton Ginned in Louisiana, 1928-60 32
Table 6. Spotted Cotton Ginned in Louisiana, 1928-60 34
Table 7. Tinged, Yellow Stained, Gray, and Below Grade Cotton Ginned in Louisiana, 1928-60 36

TABLES

Page

Table 8. Grade of Upland Cotton Ginned in Louisiana, by Periods, 1939-60 38

Table 9. Grade of Upland Cotton Ginned in Louisiana, in District 1, 1943-60 43

Table 10. Grade of Upland Cotton Ginned in Louisiana, in District 2, 1943-60 44

Table 11. Grade of Upland Cotton Ginned in Louisiana, in District 3, 1943-60 45

Table 12. Grade of Upland Cotton Ginned in Louisiana, in District 4, 1943-60 46

Table 13. Staple Length of Upland Cotton Ginned in Louisiana, 1928-60 47

Table 14. Staple Length of Upland Cotton Ginned in Louisiana, 1938-60 49

Table 15. Staple Length of Upland Cotton Ginned in Louisiana, Per Cent of Total, by Ginning Periods, 1938-60 51

Table 16. Staple Length of Upland Cotton Ginned in Louisiana in District 1, 1939-60 55

Table 17. Staple Length of Upland Cotton Ginned in Louisiana in District 2, 1939-60 56

Table 18. Staple Length of Upland Cotton Ginned in Louisiana, in District 3, 1939-60 57

Table 19. Staple Length of Upland Cotton Ginned in Louisiana, in District 4, 1939-60 58

Table 20. Preparation of Upland Cotton in Louisiana, by Periods, 1933-60 59

Table 21. Results of Classification, Fiber Tests, Carded Yarn Processing Tests and Chemical Finishing Tests for Specified Varieties of Cotton Grown in Designated Market Areas, Louisiana, 1951-58 64

Table 22. Fiber Tests and Carded Yarn Processing Test Results by Market Areas, Louisiana, 1959 84

Table 23. Fiber Tests and Carded Yarn Processing Test Results by Market Areas, Louisiana, 1960 90

Table 24. Results of Classification, Fiber Tests, Carded Yarn Processing Tests and Chemical Finishing Tests for Specified Varieties of Cotton Grown in Designated Market Areas, Louisiana, 1956-57 97

Table 25. Cotton: Carded Yarn Processing Test Results for Stardel Variety by Market Area for Samples of Model Quality, Collected at Triweekly Intervals, Crop of 1960 99

Louisiana Cotton Quality Statistics and Related Data

JAMES F. HUDSON*

Summary

Cotton quality is a matter of concern to all of the people and agencies in Louisiana who are involved in the production or handling of cotton as well as to the cotton merchants and mills located outside the state who purchase and process it.

Considerable data on Louisiana cotton quality exists in various publications of the United States Department of Agriculture. However, these data are scattered and are not readily available to interested users. This report brings together these data and presents them in a more usable form.

Detailed statistical data are presented on grade, staple length and ginning preparation of Louisiana cotton from 1928 to date. Annual fiber and spinning test results are presented for the period 1951 through 1960. Fiber and spinning test results for the Stardel variety are presented separately for those years in which test data are available on this variety.

Data are also presented on factors related to cotton quality, such as varieties planted, methods of harvest, gin equipment, production areas, soil, climate, markets and facilities. Data on varieties are presented by years, districts and parishes. Annual data on methods of harvest are presented for the period 1949-60.

Cotton production in the state is concentrated primarily in the Red River, Ouachita and Mississippi River Delta areas. Deltapine is the predominant variety planted in each area and accounts for approximately 90 per cent of the total state acreage. Considerable improvement has been made in the proportion of the cotton crop with staple lengths of one inch and longer; however, there has been a decrease in recent years in the proportion of the crop with staple lengths of one and three thirty-seconds inches and longer. The grade of Louisiana cotton has shown a downward trend over the period 1928-59, reflecting the increased use of mechanical pickers. On the other hand, the amount of rough gin preparation has decreased materially, reflecting the use of more modern and elaborate gin equipment. In general, the fiber test results indicate that Louisiana cotton is average in most of its fiber characteristics. Some varietal differences are evident, especially for the Stardel variety, which is superior to the Deltapine in strength.

Introduction

Cotton is the largest source of cash farm income in Louisiana. Because of its wide distribution within the state, cotton affects the welfare of more farm people than any other farm commodity. The total cash receipts from cotton and cottonseed in Louisiana during 1959 amounted to 90.8 million dollars. This figure represents 23.5 per cent of the total cash receipts from all farm commodities produced in the state and 42 per cent of the cash receipts from all crops.

---

*Associate Professor, Department of Agricultural Economics.

Louisiana firms directly related to cotton represent an investment of millions of dollars and employ thousands of persons. There are approximately 250 gins, 14 oil mills, 30 compresses and/or warehouses, and 82 cotton merchants located in Louisiana who handle the four to five hundred thousand bales of cotton produced annually in the state.

Cotton quality is a matter of concern to all of the persons and agencies in Louisiana involved in the handling of cotton as well as the cotton merchants and mills located outside of the state.

Purpose

The primary purpose of this report is to make available to cotton producers, buyers, mills, and other interested parties information concerning the quality of Louisiana cotton. Historical data are presented as a means of indicating trends in cotton quality over time. Data are presented by periods during the season and by areas in order to facilitate the location of desired qualities by interested agencies. Supplemental data on varieties, weather conditions, gin equipment, method of harvest and soil types are presented as a further aid in identifying cotton quality as it is related to these various aspects.

It is hoped that the information included in this report will be of value to those interested in Louisiana cotton and will enable them to determine the approximate volume of any quality of cotton which can be expected to be available during the season and within the various areas of the state. The data should be of value to agricultural agencies, cotton producers and ginners as a source of statistical information and as an aid to further cotton quality improvement in the state.

Source of Data

The data included in this report were assembled primarily from annual reports of the United States Department of Agriculture, Agricultural Marketing Service, Cotton Division, formerly the Production and Marketing Administration, Cotton Branch. Grade, staple and preparation data were obtained from the annual publication entitled "Cotton Quality Statistics, United States," the data on fiber and processing tests were obtained from the annual publication entitled "Annual Cotton Quality Survey," and the data on varieties were obtained from the annual publication entitled "Cotton Varieties Planted." The Louisiana Agricultural Experiment Station and the Louisiana State Department of Agriculture and Immigration cooperate with the United States Department of Agriculture in assembling the information on which the above reports are based.

The estimates of the grade and staple length of ginnings for Louisiana are based on the classification of samples representing approximately 10 per cent of the cotton crop in the state. The proportions of the various qualities found in the samples classed were applied to total ginnings as reported by the Bureau of the Census. In preparing the estimates, the state was divided into four cotton quality reporting districts (Figure 1). Samples classed were applied to ginnings by ginning periods as well as by districts.

The annual variety data are based principally on estimates furnished by cotton ginners for the territories served by their gins. Supplemental information was obtained from others closely associated with cotton culture in their respective areas, such as seed producers, seed dealers and county agents.

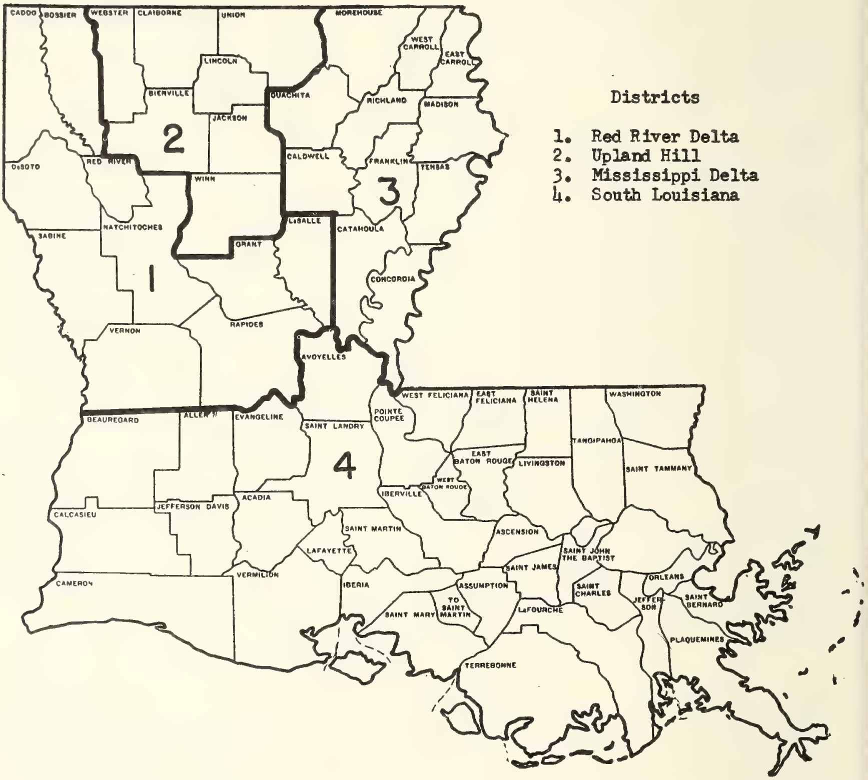
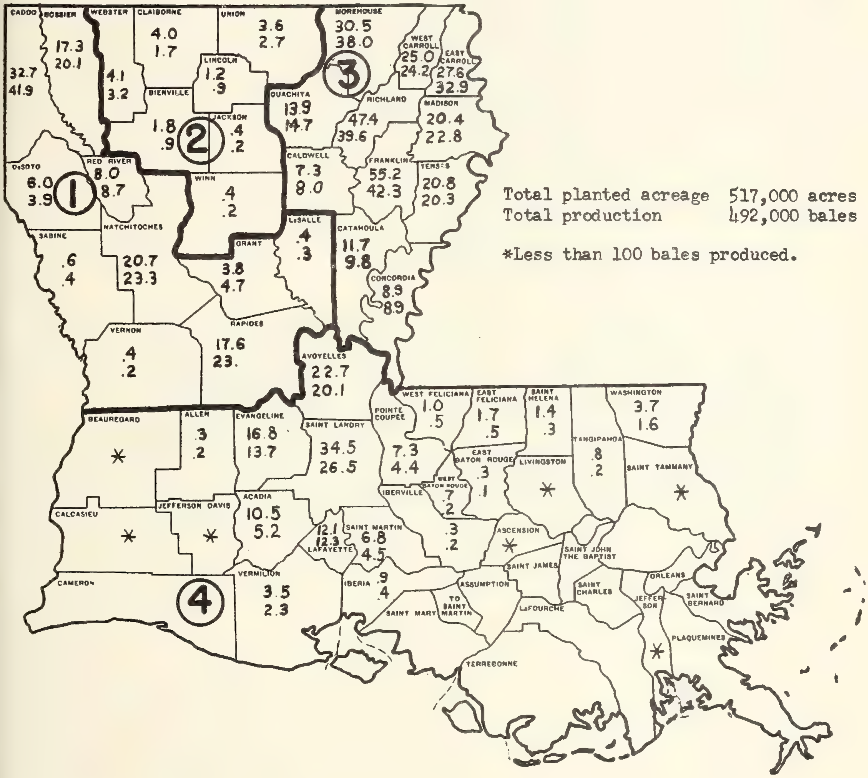


FIGURE 1.—Cotton Quality Reporting Districts, Louisiana

The procedures for selecting samples for the annual cotton quality survey were designed to represent the major varieties in each crop reporting district and to provide additional selections in proportion to production. In most cases, each survey point or gin community selected for collection of samples represents approximately 30,000 to 100,000 bales of the specified variety in the general market area.

Production Areas, Soil and Climate

The major cotton production areas of the state are located in the Mississippi, Red River and Ouachita River valleys and on the Macon Ridge. Caddo, Franklin, Richland, Morehouse, St. Landry and Avoyelles are the leading cotton producing parishes in the state. Very little cotton is presently being produced in the Upland Hill area of the state, District 2, or in the hill areas of northwest and southeast Louisiana. The planted acreage and production by parishes for the 1959 crop are shown in Figure 2.



Total planted acreage 517,000 acres
Total production 492,000 bales

*Less than 100 bales produced.

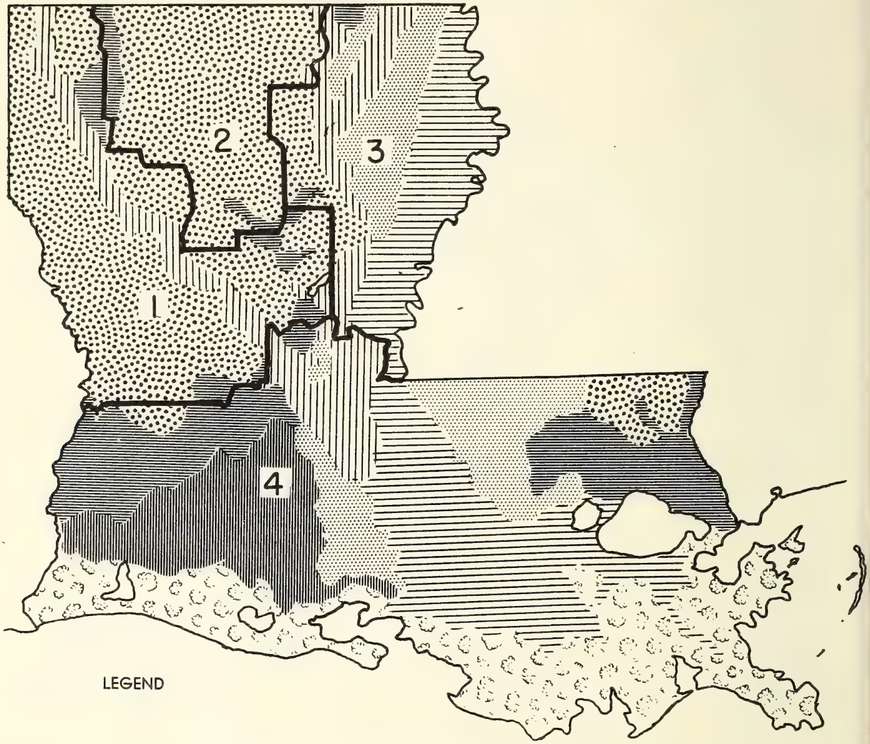
Source: Louisiana Crop Reporting Service, U. S. Department of Agriculture, AMS, Office of the Agricultural Statistician, Alexandria, Louisiana

FIGURE 2.—Planted Acreage and Production of Cotton by Parishes, Louisiana, 1959 (1,000 acres, 1,000 bales)

Cotton production in the state is confined primarily to the alluvial and terrace soils. Alluvial soils refer to the soils of the Red, Ouachita and Mississippi River bottoms. These soils range from very fine sandy loam through silt loam and silty clay loam to clay loam and clay and are relatively the most fertile soils in the state. Terrace soils refer to soils of the flatwoods areas of the Coastal Plain and Pleistocene terraces, Mississippi

River terraces and loessial hills, and Coastal prairies. These soils range from very fine sandy loam through silt loam to silty clay loam and are, in general, only moderately fertile.[1] A more detailed listing of the general soil areas of Louisiana is shown in Figure 3.

The principal influences that determine the climate of Louisiana are its subtropical latitude and its proximity to the Gulf of Mexico. Elevation is a minor factor. In summer the prevailing southerly winds provide a



⁙ Hilly to Gently Rolling Areas of the Coastal Plain—Kirvin, Shubuta, Cuthbert, Susquehanna, Orangeburg, Ruston, Bowie, Etc.

▤ Flatwoods Areas of the Coastal Plain and Pleistocene Terraces—Beauregard, Caddo, Pheba, Kalmia, Myatt, Etc.

▥ Coastal Prairies—Calcasieu, Crowley, Lake Charles, Iberia, Waverly, Etc.

▒ Mississippi Terraces (Pleistocene) and Loessial Hills—Memphis, Grenada, Lexington, Lintonia, Richland, Olivier, Calhoun, Vicksburg, Etc.

▥ Ouachita River and Red River Bottoms—Pulaski, Gallion, Portland, Buxin, Perry, Yahola, Miller, Etc.

▤ Mississippi River Bottom—Robinsonville, Commerce, Mhoon, Sharkey, Etc.

▨ Tidal Marsh

FIGURE 3.—General Soil Areas or Associations of Louisiana (Compiled by M. B. Sturgis)

moist, tropical climate when the atmospheric pressure decreases westward from the Atlantic Ocean, a condition favorable for afternoon thundershowers when the ocean high pressure area is not too far west. When the pressure distribution is altered so as to bring westerly to northerly winds, periods of hotter and drier weather interrupt the prevailing moist condition.[2]

---

[1] "Fertilizer Recommendations For Louisiana," Louisiana Agricultural Experiment Station, Circular No. 65, June 1960.

Climatic conditions vary somewhat between the different areas of the state. The South Louisiana area has a longer average growing season without killing frost and has a higher average rainfall than the northern areas of the state. The cotton crop is generally two to three weeks earlier in the South Louisiana area than in the northern part of the state. The northwestern area has a longer growing season and lower average warm-season precipitation than the northeastern area. These and other differences between areas are shown in Figure 4.

Method of Harvest

There has been considerable change in the method of harvest of Louisiana cotton during the past ten years. As late as the 1949-50 crop, 90 per cent of the cotton produced in Louisiana was hand picked. Since

Table 1.—Method of Harvesting Cotton in Louisiana, 1949-50 to 1960-61

Year	Method of harvest				
	Hand		Machine1/		
	Picked	Stripped	Picked	Stripped	Other
	Per cent		Per cent		Per cent
1949-50	99	1	1/	1/	*
1951-52	84	5	1/	1/	11
1952-53	86	1	1/	1/	13
1953-54	64	2	1/	1/	34
1954-55	58	14	28	*	-
1955-56	69	3	28	-	-
1956-57	64	5	31	*	-
1957-58	50	15	35	*	-
1958-59	53	4	43	-	-
1959-60	45	5	50	-	-
1960-61	40	11	49	-	-

1/Was not reported before 1954-55.
*Less than .05 per cent.

---

[2] "Climate and Man, 1941 Yearbook of Agriculture," United States Department of Agriculture, Washington, D. C., 1941, p. 902.

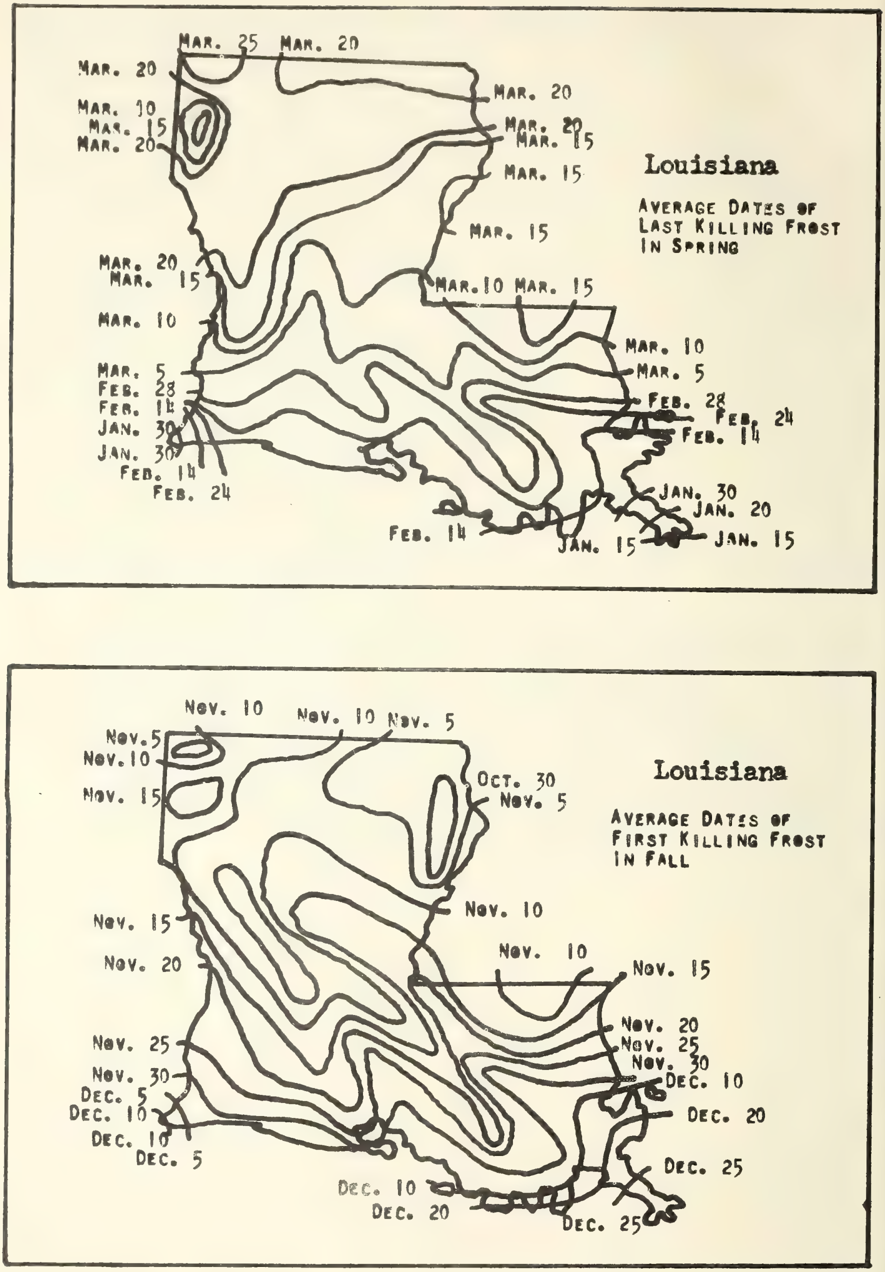
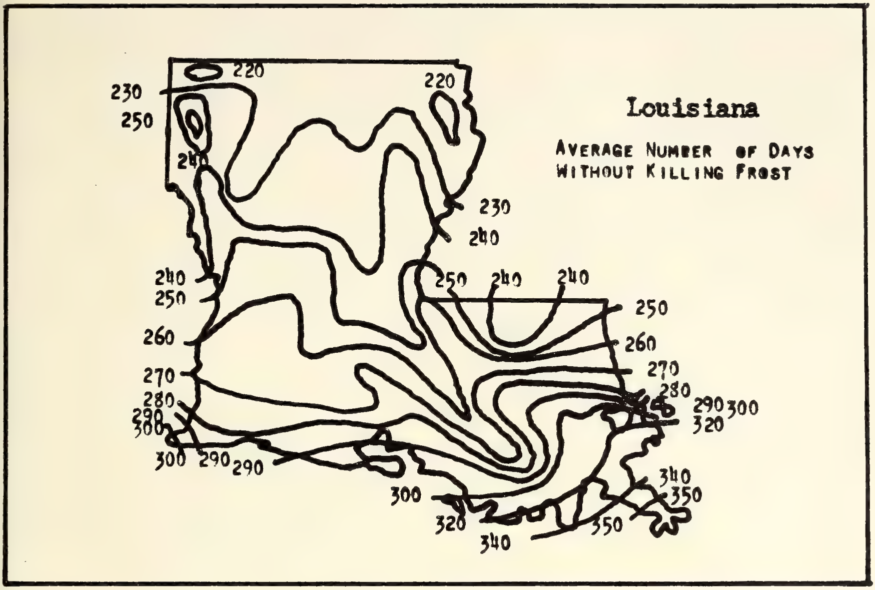


FIGURE 4.—Climate of Louisiana

Continued→



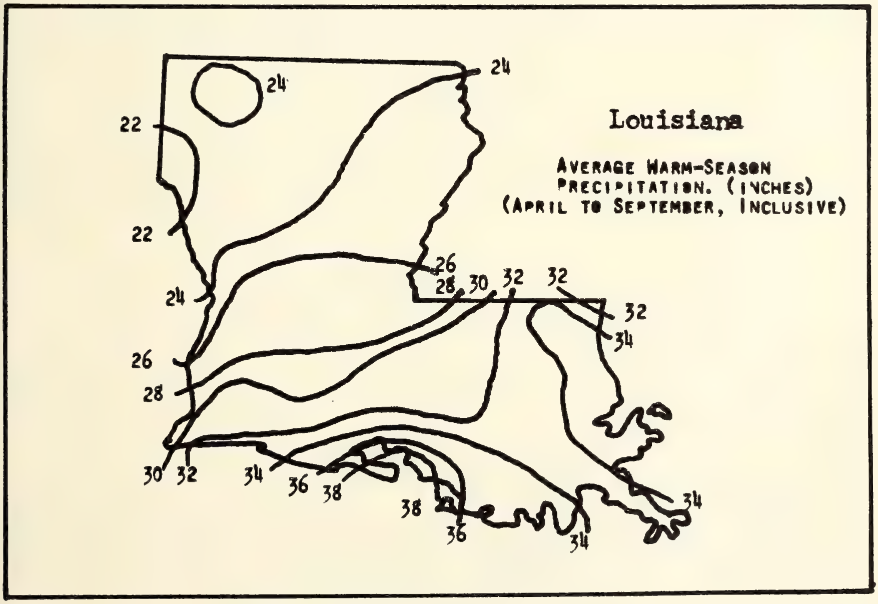

Louisiana
AVERAGE WARM-SEASON PRECIPITATION. (INCHES)
(APRIL TO SEPTEMBER, INCLUSIVE)
24
24
22
22
24
26
28
26
28
30
32
32
32
34
30
32
34
36
38
38
36
34
34

FIGURE 4 (Continued)

then, however, the percentage of the crop hand picked has been dropping steadily (Figure 5). There has been a corresponding increase in the proportion of the crop harvested by machine, with 50 per cent of the crop being machine picked during the 1959-60 season (Table 1). Only a minor amount of cotton is hand stripped, and less than .05 per cent is machine stripped in the state.

A higher proportion of the crop is machine picked in the Red, Ouachita and Mississippi River Delta areas as compared to the Upland Hill and South Louisiana areas of the state. There has been some increase, however, in the use of machines in South Louisiana, especially in the South Central area.

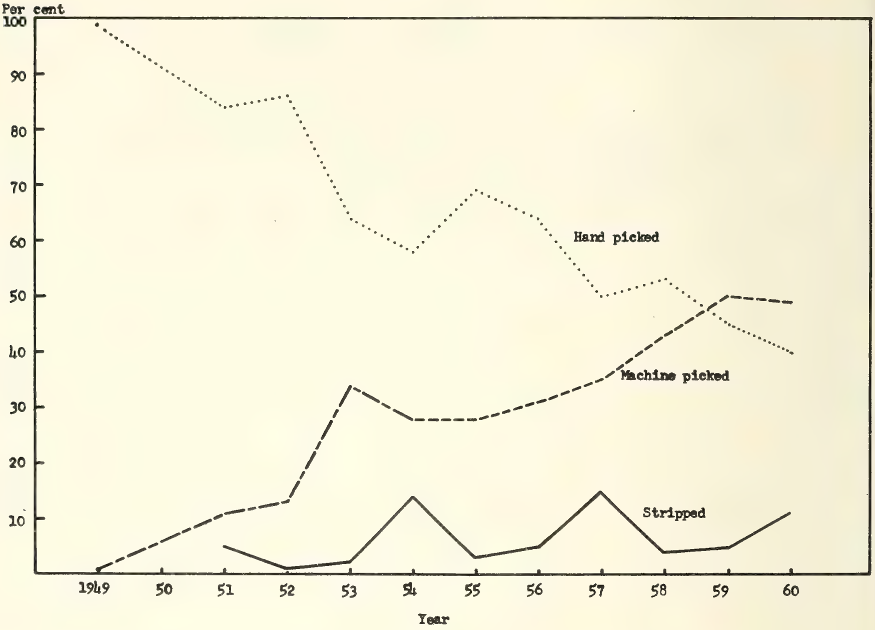


FIGURE 5.—Method of Harvesting Cotton, Louisiana, 1949-60

Gin Equipment

The trend in the ginning industry in Louisiana during recent years has been toward a substantial reduction in the number of gin plants and large gains in the installation of cleaning and drying equipment. A summary of the various types of machinery and equipment in cotton gins in Louisiana at the close of the 1956-57 season, the 1958-59 season, and the 1960-61 season is given in Table 2. Practically all of the gins in Louisiana are presently equipped with overhead cleaners and one or more driers and lint cleaners. The number of elaborately equipped gins has been increasing while the number of simple equipped gins has been reduced materially.

In general, the more elaborately equipped gins are located in the areas where a high proportion of the crop is machine harvested and where larger volumes are available. Less elaborately equipped gins are found in those areas of the state where there has been a relative decline in acres planted, primarily the Upland Hill area and the southeast and southwest areas of the state.

Markets and Facilities

The major cotton marketing centers in Louisiana, in addition to New Orleans, are Shreveport, Monroe and Alexandria. Other important markets are located at Natchitoches, Opelousas, Rayville, Winnsboro, Ferriday, Tallulah and Lake Providence (Figure 6). Minor markets are located in the other towns scattered throughout the cotton producing areas. The more important markets have several cotton firms located within the market, are served by compress and warehouse facilities and have adequate rail and highway connections. The names and addresses of most of the cotton buyers and firms located in Louisiana are listed in "Davidson's Textile Blue Book."

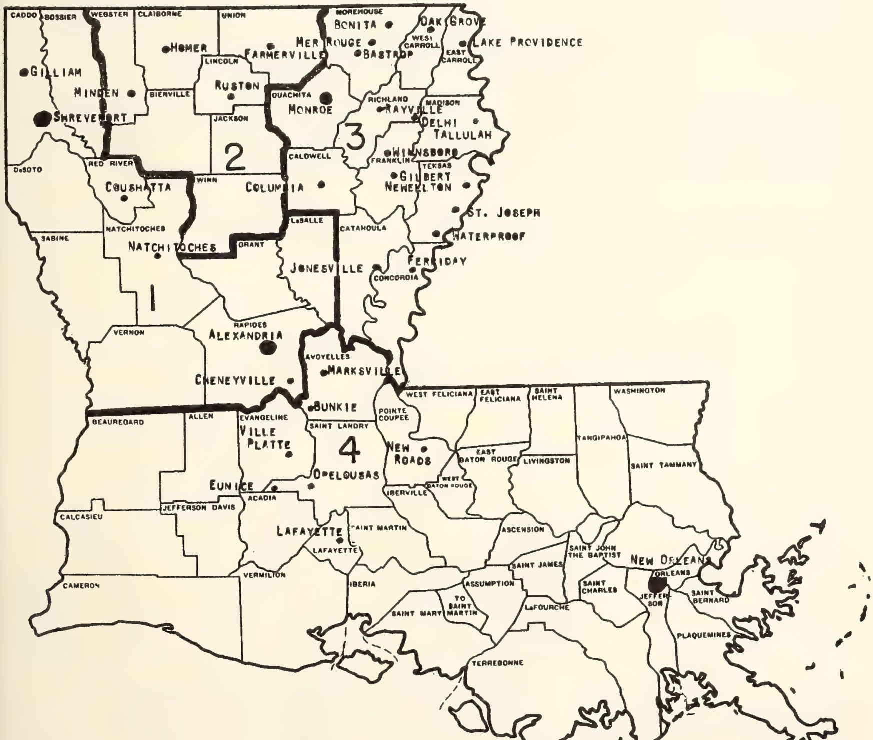


FIGURE 6.—Location of Cotton Market Centers, Louisiana

Varieties Planted

Deltapine has been the leading variety of cotton in Louisiana during recent years. It accounted for 90 per cent or more of the planted acreage in the state each year during the period 1950-60 except for 1960, when it was reduced to 84 per cent (Table 3). It accounted for approximately 100 per cent of the acreage planted in several areas of the state. Other important varieties planted include: Coker 100, Delfos, Fox, Stoneville, Deltapine Smooth Leaf, Stardel, Auburn and Rex.

Deltapine Smooth Leaf, Stardel, Auburn and Coker 100 were the other major varieties planted in District 1. The largest percentage of acreage planted to Stardel occurred in Bossier Parish. In District 2, Rex, Empire, Coker 100 and Auburn were the other major varieties. Deltapine Smooth Leaf, Fox, and Stoneville were the other major varieties in District 3. East Carroll, Morehouse and Tensas parishes accounted for a major part of the Deltapine Smooth Leaf acreage in this area. Stoneville was the other major variety planted in District 4, with small amounts of Coker 100, Fox and Plains reported (Table 4).

Increased plantings of the Stardel variety have been reported in Red River, Bossier, East Carroll, Madison and Morehouse parishes for the 1961-62 crop.

Grade, Staple and Preparation

There has been a downward trend in the grade of Louisiana cotton over the period from 1928 through 1960. This has been reflected by a decline in the proportion of cotton grading Middling white or better

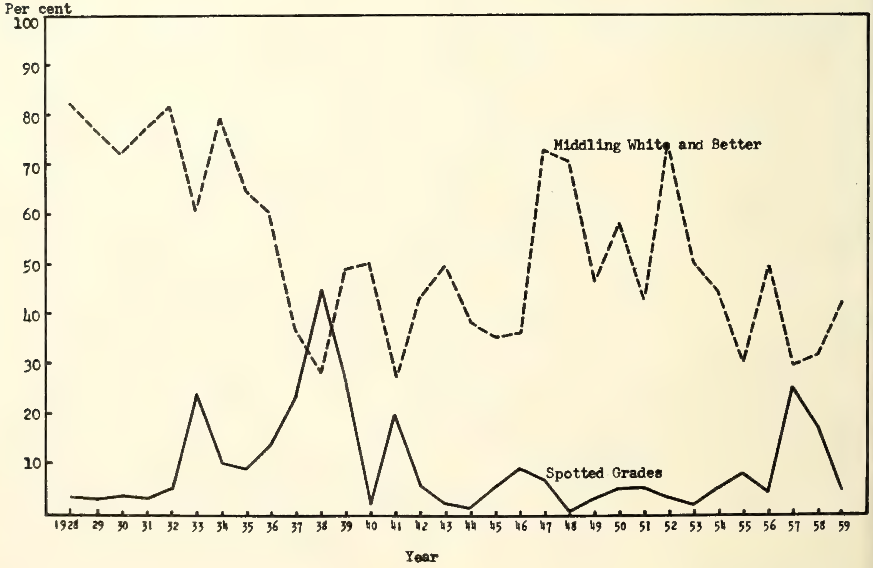


FIGURE 7.—Proportion of Cotton Grading Middling White and Better, and Spotted, Louisiana, 1928-59

(Figure 7). Most of this decline in grade occurred prior to 1940. There was a general improvement during the period 1940 through 1952, and another decline during the period since 1952. The decline in grade during the last ten years may be partially related to the increased use of mechanical pickers in the state. In recent years well over half of the Louisiana crop fell within the Middling and Strict Low Middling white grades. The grades of Strict Middling and Low Middling white account for another 15 to 20 per cent of the crop.

The grade of Louisiana cotton by years, by districts and by periods during the year is presented in Tables 5 through 12.

The average staple length of Louisiana cotton has increased considerably since 1928. The proportion of the crop stapling longer than 1 inch has increased from a low of 13 per cent in 1928 to more than 98 per cent in 1959-60 (Figure 8). This increase in staple length may be attributed primarily to the shift away from the old Half and Half varieties to the longer staple Deltapine varieties. From 85 to 90 per cent of the Louisiana crop falls within the one and one thirty-second to one and one-sixteenth inch staple length group. This is primarily accounted for by the high proportion of the crop planted to one variety, Deltapine.

While the proportion of cotton having a staple length longer than an inch has increased materially, there has been a noticeable decline in the proportion of cotton having a staple length one and three thirty-seconds inches and longer, especially during the past few years. In fact, a smaller proportion of the crop was one and three thirty-seconds and longer during the past four seasons than during the period 1928-34. This also may be

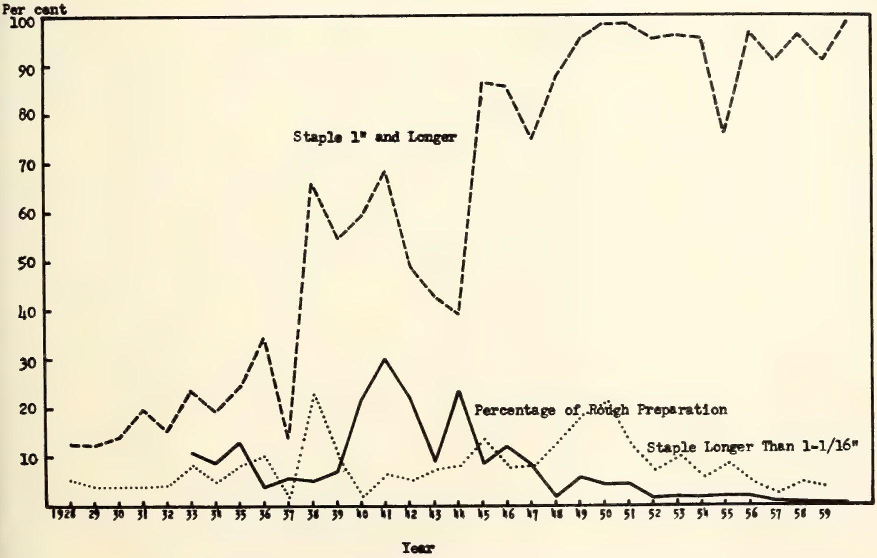


FIGURE 8.—Proportion of Cotton with Staple Length Longer than One Inch, Longer than One and One-Sixteenth Inches and Percentage of Rough Preparation, Louisiana, 1928-59

partially accounted for by the shift in varieties planted, with more of the acreage being planted to Deltapine varieties and less to the longer staple varieties such as Coker, Delfos and Stoneville.

The staple length of Louisiana cotton by years, by districts and by periods during the year is presented in Tables 13 through 19.

Rough preparation of cotton was a major problem in Louisiana during the period from 1940 through 1948 (Figure 8). The high proportion of rough preparation during this period materially reduced the over-all grade of Louisiana cotton and caused considerable concern in the marketing of the crop. With the installation of driers and improved ginning practices, however, this problem has virtually been eliminated in recent years. Since 1957 only a very minor proportion of the crop has been reduced in grade because of rough preparation. The preparation of Louisiana cotton by years and periods during the year is presented in Table 20.

Fiber and Spinning Test Results

Fiber and spinning test results have been generally available since 1946. There have been shifts in sampling points within the state during this period, as well as some changes in testing methods used. Table 21 presents these test results for the Deltapine variety by locations and by years for the period 1951-58, and Tables 22 and 23 present similar results for 1959-60. Table 24 presents these test results for the Stardel variety.

In general the fiber test results indicate that Louisiana cotton is average in most of its fiber characteristics. The characteristics are fairly uniform for the various sampling points and from season to season; however, extreme weather conditions during certain years are reflected in the test results. Some varietal differences may be noted, especially in regard to the Stardel variety. Test results indicate that the Stardel variety is superior to the Deltapine varieties in strength.

The basis for interpreting the fiber and processing test results may be obtained by referring to any of the "Annual Cotton Quality Survey" publications issued by the United States Department of Agriculture, Agricultural Marketing Service, Washington, D. C.

Table 2.—Cotton Gin Equipment, Louisiana, 1957, 1959, and 1961

Districts	Gins			Gins having batteries with							
				Driers							
	Total Batteries	Single Battery	Double Battery	Total Batteries	Stage of Drying 1	2	3	Overhead cleaners	Burr machines	Stick & Green leaf machines	Lint cleaners
1957											
District 1	69	67	1	61	17	38	6	57	36	5	40
District 2	24	24	-	12	11	1	-	16	1	1	-
District 3	116	112	2	111	24	80	7	102	82	25*	73
District 4	124	124	-	117	68	46	3	75	22	6	28
Total (1957)	333	327	3	301	120	165	16	250	141	37*	141
Total (1959)	260	**	**	250	78	115	17	**	114	44	228
Total (1961)	236	**	**	229	61	145	23	**	110	39	224

Districts	Gins Having Moisture Meters	Gins Having Various Number of Saws Per Stand: Less than 70	80	90	Gins Pressing Bales to Various Densities: Flat	Standard	Gins Using Various Baggings: Jute	Sugar	Both
1957									
District 1	2	8	42	19	69	-	18	51	-
District 2	1	4	20	-	24	-	12	12	-
District 3	-	6	73	37	116	-	58	53	5
District 4	2	23	82	19	124	-	12	108	4
Total (1957)	5	41	217	118	333	-	100	224	9
Total (1959)	**	**	**	**	**	**	**	**	**
Total (1961)	**	**	**	**	**	**	**	**	**

*Includes one battery with 2 stick and green leaf machines.
**Unavailable.

Table 3.—Estimated Percentage of Cotton Acreage Planted to Specified Varieties, By Districts, Louisiana, 1950-1961

Districts	Ginnings	Variety Coker 100	Delfos	Delta-pine	Fox	Stone-ville	Deltapine Smoothleaf	Other[1/]	Total
	1,000 bales	Per cent	Per cent	Per cent	Per cent	Per cent	Per cent	Per cent	Per cent
District 1									
1950	119	1	-	98	-	1	***	*	100
1951	183	*	*	96	-	2	***	2	100
1952	197	*	-	99	-	1	***	*	100
1953	210	1	-	99	-	*	***	*	100
1954	119	*	-	98	1	*	***	1	100
1955	128	1	2	96	*	*	***	1	100
1956	103	1	*	96	*	*	***	3	100
1957	78	1	-	93	-	*	***	6	100
1958	72	-	-	95	-	-	***	5	100
1959	133	*	*	92	1	-	***	7	100
1960	126	2	***	84	*	*	5	9	100
1961	-	-	-	50	3	1	35	11	100
District 2									
1950	15	1	-	94	-	2	***	3	100
1951	24	1	-	96	-	2	***	1	100
1952	22	1	-	94	-	1	***	4	100
1953	22	6	-	91	-	1	***	2	100
1954	15	4	-	91	-	*	***	5	100
1955	22	6	-	88	-	1	***	5	100
1956	15	6	-	86	-	*	***	8	100
1957	8	5	-	92	-	*	***	3	100
1958	3	5	-	87	-	-	***	8	100
1959	3	2	-	80	-	-	***	18	100
1960	2	7	***	58	-	-	-	35	100
1961	-	-	-	21	-	-	-	79	100
District 3									
1950	185	9	2	83	-	3	***	3	100
1951	302	8	1	85	-	4	***	2	100
1952	313	2	1	94	-	3	***	*	100
1953	414	1	1	93	-	1	***	4	100
1954	248	*	3	91	4	1	***	1	100
1955	278	*	4	92	3	*	***	1	100
1956	286	*	2	95	2	*	***	1	100
1957	186	1	3	91	2	2	***	1	100
1958	153	2	1	92	1	2	***	2	100
1959	260	1	3	91	2	1	***	2	100
1960	269	-	***	82	2	2	11	3	100
1961	-	-	-	43	-	5	46	6	100
District 4									
1950	103	*	-	96	-	3	***	1	100
1951	240	1	-	95	-	4	***	*	100
1952	207	-	-	97	-	3	***	*	100
1953	149	*	-	96	-	3	***	*	100
1954	180	*	-	97	*	2	***	1	100
1955	144	-	-	96	-	4	***	*	100
1956	166	*	-	90	2	7	***	1	100
1957	74	*	-	85	*	13	***	2	100
1958	65	1	-	87	-	11	***	1	100
1959	91	*	-	89	*	10	***	1	100
1960	99	1	***	90	1	7	*	1	100
1961	-	-	-	29	*	9	60	2	100

(Continued)

Table 3.— (Continued)

State	Ginnings	Variety							
		Coker 100	Delfos	Deltapine	Fox	Stoneville	Deltapine Smoothleaf	Other[1/]	Total
	1,000 bales	Per cent	Per cent	Per cent	Per cent	Per cent	Per cent	Per cent	Per cent
State									
1950	422	4	1	91	-	2	***	2	100
1951	749	4	1	91	-	3	***	1	100
1952	739	1	*	96	-	3	***	*	100
1953	795	1	*	96	-	1	***	2	100
1954	562	*	2	94	2	1	***	1	100
1955	572	1	2	94	1	1	***	1	100
1956	570	1	1	94	1	2	***	1	100
1957	346	1	2	90	1	5	***	1	100
1958	293	1	1	92	1	3	***	2	100
1959	487	1	1	90	1	3	***	4	100
1960	496	1	***	84	1	2	7	5	100
1961	-	-	-	41	3	5	45	6	100

[1/] Includes small percentage planted to varieties other than those specified.

*Less than .05 per cent.

***Not reported as a specified variety this season.

Table 4.— Estimated Percentage of Cotton Acreage Planted to Specified Varieties by Parishes and Districts 1955-1961

District and Parish	Gins	Ginnings	Variety										
			Coker 100	Delfos	Deltapine	Fox	Stoneville	Stardel	Hibred & Half & Half	Auburn 56	Deltapine Smoothleaf	Rex	Other [1]	Total
	Number	1,000 bales	Per cent	Per cent	Per cent	Per cent	Per cent	Per cent	Per cent	Per cent	Per cent	Per cent	Per cent	Per cent
District 1														
Bossier														
1955	10	21.5	-	5	92	2	-	***	***	***	***	***	1	100
1956	9	16.2	-	***	95	1	-	3	***	***	***	***	1	100
1957	8	12.4	-	***	83	***	-	16	*	***	***	***	1	100
1958	8	13.5	***	***	86	***	***	13	***	-	***	***	1	100
1959	8	22.4	-	-	80	3	***	16	***	-	***	***	1	100
1960	8	21.6	-	***	73	***	***	16	***	-	6	3	2	100
1961	8	-	***	***	50	-	-	11	***	3	33	***	3	100
Caddo														
1955	22	47.8	-	2	97	*	-	***	***	***	***	***	1	100
1956	21	27.8	-	***	95	-	-	2	***	***	***	***	2	100
1957	17	26.9	-	***	94	***	-	1	-	***	***	***	5	100
1958	15	28.9	***	***	97	***	***	-	***	1	***	***	2	100
1959	14	42.1	-	-	95	1	***	-	***	2	***	***	2	100
1960	13	34.8	-	***	96	***	***	-	***	-	1	1	2	100
1961	12	-	***	***	53	8	-	-	***	3	36	***	-	100
Desoto														
1955	8	6.6	2	-	96	-	-	***	***	***	***	***	2	100
1956	7	3.9	-	***	98	-	-	-	***	***	***	***	2	100
1957	6	3.2	-	***	95	***	-	-	2	***	***	***	3	100
1958	5	1.7	***	***	99	***	***	-	***	-	***	***	1	100
1959	3	**	-	-	99	-	***	-	***	-	***	***	1	100
1960**														
1961**														
Grant														
1955	4	**	2	-	86	2	-	***	***	***	***	***	10	100
1956**														
1957**														
1958**														
1959**														
1960**														
1961**														

Table 4.— (Continued)

District and Parish	Gins	Ginnings	Variety											
			Coker 100	Delfos	Deltapine	Fox	Stoneville	Stardel	Hibred & Half & Half	Auburn 56	Deltapine Smoothleaf	Rex	Other 1/	Total
	Number	1,000 bales	Per cent	Per cent	Per cent	Per cent	Per cent	Per cent	Per cent	Per cent	Per cent	Per cent	Per cent	Per cent
District 1														
Natchitoches														
1955	16	17.9	4	-	95	-	-	***	***	***	***	***	1	100
1956	16	16.3	2	***	94	1	-	-	***	***	***	***	3	100
1957	16	13.5	3	***	92	***	-	-	*	***	***	***	5	100
1958	15	11.8	***	***	91	***	***	-	***	8	***	***	1	100
1959	13	22.8	-	-	95	-	***	-	***	3	***	***	2	100
1960	10	20.4	2	***	73	***	***	-	***	4	16	-	5	100
1961	10	-	***	***	57	-	-	-	***	12	29	***	2	100
Rapides														
1955	14	20.8	-	-	99	-	-	***	***	***	***	***	1	100
1956	14	25.4	-	***	99	-	-	-	***	***	***	***	1	100
1957	14	13.4	-	***	98	***	-	1	-	***	***	***	1	100
1958	12	9.7	***	***	99	***	***	-	***	-	***	***	1	100
1959	12	27.6	-	-	97	-	***	-	***	-	***	***	3	100
1960	12	30.8	-	***	86	***	***	1	***	-	2	2	9	100
1961	12	-	***	***	32	4	4	6	***	4	48	***	2	100
Red River														
1955	9	9.9	2	7	90	-	-	***	***	***	***	***	1	100
1956	8	9.0	4	***	95	-	-	-	***	***	***	***	1	100
1957	6	6.3	3	***	93	***	2	-	-	***	***	***	2	100
1958	5	4.3	***	***	98	***	***	-	***	-	***	***	2	100
1959	5	10.5	6	2	87	-	***	2	***	-	***	***	3	100
1960	5	10.2	14	***	82	***	***	-	***	-	4	-	-	100
1961	5	-	***	***	66	-	-	18	***	-	15	***	1	100
All Other														
1955	3	4.3	3	-	95	-	2	***	***	***	***	***	*	100
1956	5	4.2	-	***	92	-	3	-	***	***	***	***	5	100
1957	5	2.6	-	***	89	***	6	-	3	***	***	***	2	100
1958	3	2.5	***	***	94	***	***	-	***	5	***	***	1	100
1959	2	7.1	-	-	100	-	***	-	***	-	***	***	-	100
1960	4	7.9	-	***	77	***	***	-	***	14	8	1	*	100
1961	4	-	***	***	52	2	2	5	***	6	33	***	1	100

(Continued)

Table 4.— (Continued)

District and Parish	Gins	Ginnings	Coker 100	Delfos	Deltapine	Fox	Stoneville	Stardel	Hibred & Half & Half	Auburn 56	Deltapine Smoothleaf	Rex	Other 1/	Total
	Number	1,000 bales	Per cent	Per cent	Per cent	Per cent	Per cent	Per cent	Per cent	Per cent	Per cent	Per cent	Per cent	Per cent
District 1														
Total														
1955	86	128.0	1	2	96	*	*	***	***	***	***	***	1	100
1956	80	102.8	1	***	96	*	*	1	***	***	***	***	2	100
1957	72	78.3	1	***	93	***	*	3	-	***	***	***	3	100
1958	63	72.4	***	***	95	***	***	2	***	2	***	***	1	100
1959	57	132.5	*	*	92	1	***	3	***	1	***	***	3	100
1960	52	125.7	2	***	84	***	***	3	***	5	5	1	3	100
1961	51	-	***	***	50	3	1	5	***	5	35	***	1	100

District and Parish	Gins	Ginnings	Coker 100	Deltapine	Stoneville	Hibred & Half & Half	Stardel	Plains	Empire	Rex	Auburn 56	Rowden	Other 1/	Total
	Number	1,000 bales	Per cent	Per cent	Per cent	Per cent	Per cent	Per cent	Per cent	Per cent	Per cent	Per cent	Per cent	Per cent
District 2														
Bienville														
1955	5	3.1	1	95	-	3	***	***	***	***	***	***	1	100
1956	5	2.5	-	97	-	2	***	***	***	***	***	***	1	100
1957	4	0.9	4	95	-	-	-	***	***	***	***	***	1	100
1958	4	**	-	92	***	-	-	-	***	***	***	***	8	100
1959**														
1960**														
1961**														

(Continued)

Table 4.— (Continued)

District and Parish	Gins	Ginnings	Variety Coker 100	Delta-pine	Stone-ville	Hibred & Half & Half	Stardel	Plains	Empire	Rex	Auburn 56	Rowden	Other 1/	Total
	Number	1,000 bales	Per cent	Per cent	Per cent	Per cent	Per cent	Per cent	Per cent	Per cent	Per cent	Per cent	Per cent	Per cent
District 2														
Claiborne														
1955	7	4.8	6	87	-	5	***	***	***	***	***	***	2	100
1956	7	3.5	-	81	1	14	***	***	***	***	***	***	4	100
1957	5	2.1	2	94	-	3	-	***	***	***	***	***	1	100
1958	4	-	3	85	***	12	-	-	***	***	***	***	-	100
1959	4	1.0	-	47	***	***	***	-	6	37	***	-	5	100
1960	3	0.9	6	91	***	***	***	***	-	1	1	***	1	100
1961**														
Lincoln														
1955	4	3.0	7	78	2	13	***	***	***	***	***	***	-	100
1956	4	2.5	5	91	-	3	***	***	***	***	***	***	1	100
1957	4	1.3	8	89	1	-	-	***	***	***	***	***	2	100
1958	4	**	-	92	***	1	4	-	***	***	***	***	3	100
1959**														
1960**														
1961	3	0.7	11	12	***	***	***	***	***	61	16	***	-	100
Union														
1955	3	4.5	14	78	3	5	***	***	***	***	***	***	-	100
1956	3	2.9	22	70	-	-	***	***	***	***	***	***	8	100
1957	3	**	12	84	-	2	2	***	***	***	***	***	-	100
1958**														
1959**														
1960**														
1961**														
Webster														
1955	7	6.0	-	97	-	1	***	***	***	***	***	***	2	100
1956	6	3.2	-	97	-	2	***	***	***	***	***	***	1	100
1957	5	2.2	-	97	-	1	-	***	***	***	***	***	2	100
1958	3	1.0	-	90	***	-	-	7	***	***	***	***	3	100
1959	3	**	-	89	***	***	***	6	-	-	***	-	5	100
1960**														
1961**														

(Continued)

Table 4.— (Continued)

District and Parish	Gins	Ginnings	Coker 100	Deltapine	Stoneville	Hibred & Half & Half	Stardel	Plains	Empire	Rex	Auburn 56	Rowden	Other 1/	Total
	Number	1,000 bales	Per cent	Per cent	Per cent	Per cent	Per cent	Per cent	Per cent	Per cent	Per cent	Per cent	Per cent	Per cent
District 2														
All Other														
1955	3	0.8	13	84	-	3	***	***	***	***	***	***	-	100
1956	2	0.2	33	58	-	9	***	***	***	***	***	***	-	100
1957	1	1.5	25	75	-	-	-	***	***	***	***	***	-	100
1958	2	0.7	20	80	***	-	-	-	***	***	***	***	-	100
1959	5	2.4	4	47	***	***	***	-	6	37	***	-	6	100
1960	5	1.7	7	45	***	***	***	***	9	34	5	***	-	100
1961	3	-	2	27	***	***	***	***	***	19	52	***	-	100
Total														
1955	29	22.2	6	87	1	5	***	***	***	***	***	***	1	100
1956	27	14.8	6	86	*	5	***	***	***	***	***	***	3	100
1957	22	8.0	5	92	*	1	*	***	***	***	***	***	2	100
1958	17	2.7	5	87	***	3	1	2	***	***	***	***	2	100
1959	12	3.3	2	80	***	***	***	2	2	9	***	1	4	100
1960	8	2.4	7	58	***	***	***	***	6	25	4	***	*	100
1961	6	-	5	21	***	***	***	***	***	35	39	***	-	100

District and Parish	Gins	Ginnings	Coker 100	Delfos	Deltapine	Fox	Stoneville	Stardel	Rex	Deltapine Smoothleaf	Coker 124	Other 1/	Total
	Number	1,000 bales	Per cent	Per cent	Per cent	Per cent	Per cent	Per cent	Per cent	Per cent	Per cent	Per cent	Per cent
District 3													
Caldwell													
1955	3	4.5	-	-	89	10	-	***	***	***	***	1	100
1956	3	6.4	-	-	97	2	-	***	***	***	***	1	100
1957	2	**	2	-	91	5	2	***	***	***	***	-	100
1958**													
1959**													
1960**													
1961**													

Table 4.— (Continued)

District and Parish	Gins	Ginnings	Variety										
			Coker 100	Delfos	Deltapine	Fox	Stoneville	Stardel	Rex	Deltapine Smoothleaf	Coker 124	Other[1/]	Total
	Number	1,000 bales	Per cent	Per cent	Per cent	Per cent	Per cent	Per cent	Per cent	Per cent	Per cent	Per cent	Per cent
District 3													
Catahoula													
1955	5	11.1	-	-	98	1	-	***	***	***	***	1	100
1956	5	11.6	-	-	100	-	-	***	***	***	***	-	100
1957	5	5.5	1	-	96	-	1	***	***	***	***	2	100
1958	5	3.6	1	-	96	-	1	-	***	***	***	1	100
1959	5	9.8	2	-	97	-	-	***	***	***	-	1	100
1960	5	11.2	***	-	94	1	2	***	***	-	***	3	100
1961	4	-	***	-	77	-	19	***	***	1	***	3	100
Concordia													
1955	9	10.1	1	*	98	1	-	***	***	***	***	*	100
1956	7	12.6	-	*	98	1	-	***	***	***	***	1	100
1957	7	6.5	-	3	96	-	1	***	***	***	***	-	100
1958	6	5.1	1	-	98	-	-	-	***	***	***	1	100
1959	6	9.3	1	-	89	-	7	***	***	***	-	3	100
1960	5	12.0	***	-	85	-	10	***	3	-	***	2	100
1961	6	-	***	-	39	-	17	***	***	40	***	4	100
East Carroll													
1955	15	23.3	*	28	70	2	*	***	***	***	***	-	100
1956	15	32.5	-	16	79	4	-	***	***	***	***	1	100
1957	13	20.1	-	25	61	4	2	***	***	***	***	8	100
1958	12	17.2	-	12	70	6	2	-	***	***	***	10	100
1959	12	33.6	-	24	51	-	4	***	***	***	11	10	100
1960	10	32.2	***	2	36	5	5	***	-	50	***	2	100
1961	10	-	***	9	10	2	7	***	***	69	***	3	100
Franklin													
1955	21	52.8	*	-	97	2	-	***	***	***	***	1	100
1956	22	55.0	*	-	98	1	-	***	***	***	***	1	100
1957	22	38.7	-	1	97	1	1	***	***	***	***	-	100
1958	22	28.6	-	-	97	-	1	1	***	***	***	1	100
1959	20	42.8	1	-	97	-	-	***	***	***	-	2	100
1960	19	48.1	***	-	87	-	4	***	2	5	***	2	100
1961	19	-	***	-	47	2	8	***	***	41	***	2	100

(Continued)

Table 4.— (Continued)

District and Parish	Gins	Ginnings	Variety										
			Coker 100	Delfos	Delta-pine	Fox	Stone-ville	Stardel	Rex	Deltapine Smoothleaf	Coker 124	Other 1/	Total
	Number	1,000 bales	Per cent	Per cent	Per cent	Per cent	Per cent	Per cent	Per cent	Per cent	Per cent	Per cent	Per cent
District 3													
Madison													
1955	8	17.3	-	2	87	10	*	***	***	***	***	1	100
1956	7	20.9	-	1	96	3	-	***	***	***	***	*	100
1957	8	13.8	-	2	96	-	1	***	***	***	***	1	100
1958	8	12.0	1	1	96	-	-	1	***	***	***	1	100
1959	8	18.1	-	-	94	-	-	***	***	***	-	6	100
1960	7	19.2	***	-	94	3	-	***	-	-	***	3	100
1961	7	-	***	-	57	1	5	***	***	36	***	1	100
Morehouse													
1955	12	38.8	-	-	96	3	1	***	***	***	***	*	100
1956	12	32.7	-	-	98	1	-	***	***	***	***	1	100
1957	11	22.0	-	-	94	4	1	***	***	***	***	1	100
1958	11	20.3	-	-	95	2	1	1	***	***	***	1	100
1959	11	36.4	1	-	97	-	-	***	***	***	-	2	100
1960	11	31.0	***	-	78	-	1	***	-	17	***	4	100
1961	11	-	***	-	27	5	3	***	***	64	***	1	100
Ouachita													
1955	5	14.1	1	-	99	-	-	***	***	***	***	*	100
1956	5	18.5	-	-	96	3	-	***	***	***	***	1	100
1957	5	10.9	4	-	90	5	1	***	***	***	***	-	100
1958	5	10.0	1	-	96	1	1	-	***	***	***	1	100
1959	5	17.0	1	-	94	-	-	***	***	***	-	5	100
1960	5	16.8	***	-	92	6	-	***	-	1	***	1	100
1961	5	-	***	-	43	10	-	***	***	45	***	2	100
Richland													
1955	24	55.1	1	-	97	1	-	***	***	***	***	1	100
1956	21	44.5	-	-	98	1	-	***	***	***	***	1	100
1957	20	32.7	1	-	96	2	1	***	***	***	***	-	100
1958	19	25.6	1	-	97	-	-	1	***	***	***	1	100
1959	20	43.4	2	-	96	-	1	***	***	***	-	1	100
1960	17	44.5	***	-	96	-	-	***	-	-	***	4	100
1961	17	-	***	-	50	-	4	***	***	43	***	3	100

Table 4.— (Continued)

District and Parish	Gins	Ginnings	Variety									
			Coker 100	Delfos	Deltapine	Fox	Stoneville	Stardel	Rex	Deltapine Smoothleaf	Coker 124	Other 1/	Total
	Number	1,000 bales	Per cent	Per cent	Per cent	Per cent	Per cent	Per cent	Per cent	Per cent	Per cent	Per cent	Per cent
District 3													
Tensas													
1955	8	18.7	-	3	94	3	*	***	***	***	***	-	100
1956	7	25.7	1	2	92	4	-	***	***	***	***	1	100
1957	6	16.9	1	-	96	-	1	***	***	***	***	2	100
1958	7	14.9	3	-	92	-	-	-	***	***	***	5	100
1959	7	20.0	1	-	97	-	-	***	***	***	-	2	100
1960	7	23.4	***	-	86	-	-	***	-	13	***	1	100
1961	6	-	***	-	49	6	-	***	***	40	***	5	100
West Carroll													
1955	16	32.4	2	-	95	1	1	***	***	***	***	1	100
1956	15	25.6	1	-	96	2	*	***	***	***	***	1	100
1957	13	19.0	-	-	88	-	11	***	***	***	***	1	100
1958	13	12.0	-	1	87	-	11	-	***	***	***	1	100
1959	13	24.7	1	-	94	-	3	***	***	***	-	2	100
1960	11	24.2	***	-	92	2	2	***	1	1	***	2	100
1961	11	-	***	-	57	-	-	***	***	40	***	3	100
All Other													
1958	2	3.3	1	-	97	1	-	-	***	***	***	1	100
1959	2	5.2	3	-	85	10	-	***	***	***	-	2	100
1960	2	6.8	***	-	68	27	-	***	-	-	***	5	100
1961	2	-	***	-	18	32	13	***	***	37	***	-	100
Total													
1955	126	278.2	*	4	92	3	*	***	***	***	***	1	100
1956	119	286.0	*	2	95	2	*	***	***	***	***	1	100
1957	112	186.1	1	3	91	2	2	***	***	***	***	1	100
1958	110	152.6	2	1	92	1	2	-	***	***	***	1	100
1959	109	260.3	1	3	91	2	1	***	***	***	1	2	100
1960	99	269.4	***	*	82	2	2	***	1	11	***	2	100
1961	98	-	***	1	43	3	5	***	***	46	***	2	100

(Continued)

Table 4.— (Continued)

District and Parish	Gins	Ginnings	Variety: Coker 100	Deltapine	Fox	Stoneville	Hibred & Half & Half	Stardel	Plains	Empire	Auburn	Deltapine Smoothleaf	Bobshaw	Other[1/]	Total
	Number	1,000 bales	Per cent	Per cent	Per cent	Per cent	Per cent	Per cent	Per cent	Per cent	Per cent	Per cent	Per cent	Per cent	Per cent
District 4															
Acadia															
1955	9	8.6	-	100	***	-	***	***	***	-	***	***	-	-	100
1956	8	10.2	-	100	-	-	***	***	***	-	***	***	***	-	100
1957	7	2.2	-	99	-	1	***	***	***	-	***	***	***	-	100
1958	5	4.9	-	99	***	1	***	-	***	-	***	***	***	-	100
1959	5	5.1	-	99	***	-	-	-	***	***	-	***	***	1	100
1960	4	6.4	-	97	-	1	***	***	-	***	***	2	***	-	100
1961	4	-	-	16	***	4	***	-	-	***	***	80	***	-	100
Avoyelles															
1955	22	26.9	-	99	***	-	***	***	***	-	***	***	-	1	100
1956	22	30.0	-	95	4	-	***	***	***	-	***	***	***	1	100
1957	20	12.0	-	96	2	1	***	***	***	-	***	***	***	1	100
1958	16	7.2	-	99	***	-	***	-	***	-	***	***	***	1	100
1959	12	18.5	-	97	***	1	-	1	***	***	-	***	***	1	100
1960	13	22.0	-	92	1	5	***	***	-	***	***	-	***	2	100
1961	12	-	-	49	***	5	***	6	-	***	***	39	***	1	100
East Feliciana															
1955	4	3.1	-	100	***	-	***	***	***	-	***	***	-	-	100
1956	3	3.2	-	99	-	-	***	***	***	-	***	***	***	1	100
1957	3	1.9	-	100	-	-	***	***	***	-	***	***	***	-	100
1958	3	**	-	100	***	-	***	-	***	-	***	***	***	-	100
1959**															
1960**															
1961**															

(Continued)

Table 4.— (Continued)

District and Parish	Gins	Ginnings	Variety												
			Coker 100	Deltapine	Fox	Stoneville	Hibred & Half & Half	Stardel	Plains	Empire	Auburn	Deltapine Smoothleaf	Bobshaw	Other 1/	Total
	Number	1,000 bales	Per cent	Per cent	Per cent	Per cent	Per cent	Per cent	Per cent	Per cent	Per cent	Per cent	Per cent	Per cent	Per cent
District 4															
Evangeline															
1955	15	16.5	-	99	***	-	***	***	***	-	***	***	1	-	100
1956	14	18.3	-	98	-	-	***	***	***	-	***	***	***	2	100
1957	14	7.6	-	99	-	-	***	***	***	-	***	***	***	1	100
1958	12	10.3	-	99	***	-	***	-	***	-	***	***	***	1	100
1959	11	12.7	-	100	***	-	-	-	***	***	-	***	***	-	100
1960	12	13.7	-	99	-	-	***	***	-	***	***	-	***	1	100
1961	12	-	-	-	***	1	***	***	-	***	***	98	***	1	100
Lafayette															
1955	16	14.4	-	97	***	3	***	***	***	-	***	***	-	-	100
1956	15	18.4	-	98	-	2	***	***	***	-	***	***	***	-	100
1957	13	9.1	-	88	-	12	***	***	***	-	***	***	***	-	100
1958	12	10.4	-	88	***	12	***	-	***	-	***	***	***	-	100
1959	12	12.5	-	96	***	4	-	-	***	***	-	***	***	-	100
1960	11	11.1	-	98	-	2	***	***	-	***	***	-	***	-	100
1961	9	-	-	26	***	6	***	-	-	***	***	68	***	-	100
Pointe Coupee															
1955	10	11.1	-	93	***	7	***	***	***	-	***	***	-	-	100
1956	10	14.2	2	71	-	27	***	***	***	-	***	***	***	-	100
1957	10	6.3	-	73	-	27	***	***	***	-	***	***	***	-	100
1958	7	3.7	-	50	***	50	***	-	***	-	***	***	***	-	100
1959	6	4.7	2	79	***	16	-	-	***	***	2	***	***	1	100
1960	6	4.0	-	79	-	15	***	***	-	***	***	-	***	6	100
1961	5	-	-	36	***	32	***	-	-	***	***	32	***	-	100

(Continued)

Table 4.— (Continued)

District and Parish	Gins	Ginnings	Variety												
			Coker 100	Deltapine	Fox	Stoneville	Hibred & Half & Half	Stardel	Plains	Empire	Auburn	Deltapine Smoothleaf	Bobshaw	Other 1/	Total
	Number	1,000 bales	Per cent	Per cent	Per cent	Per cent	Per cent	Per cent	Per cent	Per cent	Per cent	Per cent	Per cent	Per cent	Per cent
District 4															
St. Landry															
1955	33	38.9	-	95	***	5	***	***	***	-	***	***	-	-	100
1956	32	48.8	-	92	2	6	***	***	***	-	***	***	***	-	100
1957	32	21.1	-	83	-	16	***	***	***	-	***	***	***	1	100
1958	28	21.2	-	90	***	8	***	1	***	-	***	***	***	1	100
1959	28	25.8	-	80	***	19	-	-	***	***	1	***	***	-	100
1960	26	33.0	-	87	2	10	***	***	1	***	***	-	***	-	100
1961	26	-	-	27	***	14	***	-	1	***	***	58	***	-	100
St. Martin															
1955	6	8.0	-	74	***	26	***	***	***	-	***	***	-	-	100
1956	6	9.0	2	51	3	43	***	***	***	-	***	***	***	1	100
1957	6	3.7	-	33	-	67	***	***	***	-	***	***	***	-	100
1958	6	2.7	-	60	***	40	***	-	***	-	***	***	***	-	100
1959	6	3.8	-	51	***	39	-	-	***	***	4	***	***	6	100
1960	4	3.3	-	50	2	40	***	***	8	***	***	-	***	-	100
1961	4	-	-	26	***	40	***	-	8	***	***	25	***	1	100
Vermilion															
1955	6	5.1	-	98	***	2	***	***	***	-	***	***	-	-	100
1956	5	5.8	-	99	-	1	***	***	***	-	***	***	***	-	100
1957	4	1.6	-	100	-	-	***	***	***	-	***	***	***	-	100
1958	3	**	-	99	***	1	***	-	***	***	***	***	***	-	100
1959**															
1960**															
1961**															

(Continued)

Table 4.— (Continued)

District and Parish	Gins	Ginnings	Variety												
			Coker 100	Deltapine	Fox	Stoneville	Hibred & Half & Half	Stardel	Plains	Empire	Auburn	Deltapine Smoothleaf	Bobshaw	Other 1/	Total
	Number	1,000 bales	Per cent	Per cent	Per cent	Per cent	Per cent	Per cent	Per cent	Per cent	Per cent	Per cent	Per cent	Per cent	Per cent
District 4															
Washington															
1955	6	6.9	-	97	***	1	***	***	***	1	***	***	-	1	100
1956	5	4.7	1	90	7	-	***	***	***	2	***	***	***	-	100
1957	4	2.5	1	87	-	8	***	***	***	3	***	***	***	1	100
1958	4	1.2	16	77	***	-	***	-	***	4	***	***	***	3	100
1959	4	2.0	10	77	***	-	5	-	***	***	-	***	***	8	100
1960	4	-	20	59	-	12	***	***	6	***	***	-	***	3	100
1961**															
All Other															
1955	4	4.1	-	99	***	-	***	***	***	-	***	***	-	1	100
1956	8	3.6	-	91	-	7	***	***	***	-	***	***	***	2	100
1957	7	5.7	1	90	-	8	***	***	***	1	***	***	***	-	100
1958	1	3.6	-	85	***	15	***	-	***	-	***	***	***	-	100
1959	4	5.7	*	98	***	-	-	-	***	***	-	***	***	2	100
1960	4	5.3	1	97	-	2	***	***	-	***	***	-	***	*	100
1961	6	-	4	42	***	*	***	***	9	***	***	43	***	2	100
Total															
1955	131	143.6	-	96	***	4	***	***	***	*	***	***	*	*	100
1956	128	166.2	*	90	2	7	***	***	***	*	***	***	***	1	100
1957	120	73.5	*	85	*	13	***	***	***	*	***	***	***	2	100
1958	97	65.2	1	87	***	11	***	*	***	*	***	***	***	1	100
1959	88	90.8	*	89	***	10	*	*	***	***	1	***	***	-	100
1960	84	98.8	1	90	1	7	***	***	1	***	***	*	***	*	100
1961	78	-	*	29	***	9	***	1	1	***	***	60	***	*	100

1/ Includes small percentage planted to varieties other than those specified.

* Less than .05 per cent.

** Included in "All Other."

*** Not reported as a specified variety this season.

Table 5.— Proportion of White and Extra White Cotton Ginned in Louisiana, 1928-60[1]

Year	Grade								Total White and Extra White	
	SGM	GM	SM	M	SLM	LM	SGO	GO		
	Per cent	Per cent	Per cent	Per cent	Per cent	Per cent	Per cent	Per cent	Per cent	Bales
1928	0.34[2]	14.89	40.76	26.33	11.05	2.30	0.36	0.02	96.05	658,800
1929	0.06[3]	5.22	32.98	39.40	16.18	1.52	0.83	0.29	96.48	769,600
1930	0.09	7.38	33.48	31.62	17.05	4.19	1.26	0.37	95.44	672,700
1931	0.03	3.23	30.07	43.95	14.35	2.51	1.02	0.89	96.05	842,000
1932	0.07	5.25	38.61	37.98	10.23	1.77	0.12	0.02	94.05	563,800
1933	-	1.88	27.02	32.11	12.21	2.07	0.23	0.02	75.54	354,500
1934	0.02	7.58	39.26	32.64	8.37	1.10	0.23	0.04	89.24	422,400
1935	0.02	0.22	16.70	48.48	22.33	2.68	0.06	-	90.49	489,900
1936	0.01	2.50	23.96	34.61	19.51	4.71	0.35	0.03	85.68	636,300
1937	-	0.66	11.22	25.88	22.73	12.34	2.58	0.48	75.89	797,300
1938	-	0.39	8.38	19.59	20.64	5.22	0.35	0.02	54.59	355,636
1939	-	0.75	15.66	33.42	20.71	2.41	0.09	*	73.04	524,433
1940	-	0.09	8.29	42.29	42.38	4.66	0.16	*	97.87	439,424
1941	-	0.21	4.86	22.54	42.30	8.99	0.72	0.08	79.70	247,458
1942	0.02	0.50	6.34	36.69	42.33	6.31	0.61	0.03	92.83	531,320
1943	0.09	1.46	16.84	33.25	30.96	13.49	1.43	0.13	97.65	695,747
1944	*	0.34	4.39	34.23	52.45	6.51	0.71	0.03	98.66	586,163
1945	-	0.06	5.06	30.81	41.28	14.94	1.81	0.15	94.11	355,458
1946	0.02	0.16	4.21	32.72	45.72	6.39	0.71	0.02	89.95	221,922
1947	0.02	1.60	22.32	46.38	18.19	3.78	0.41	0.04	92.74	454,292
1948	-	0.33	22.86	47.81	20.04	6.70	1.40	0.08	99.22	726,991
1949	-	0.12	6.97	39.24	34.61	13.09	2.15	0.15	96.34	610,416

(Continued)

Table 5.— (Continued)

	Grade								Total White and Extra White	
Year	SGM	GM	SM	M	SLM	LM	SGO	GO		
	Per cent	Per cent	Per cent	Per cent	Per cent	Per cent	Per cent	Per cent	Per cent	Bales
1950	-	0.01	8.61	49.93	30.46	4.88	0.26	0.02	94.16	397,152
1951	-	0.24	7.90	34.19	36.92	13.94	1.03	0.12	94.34	705,860
1952	-	2.48	22.07	50.14	20.21	2.53	0.12	0.04	97.59	710,843
1953	-	2.28	14.45	36.68	31.40	13.23	1.33	*	97.37	744,331
1954	-	0.10	9.60	35.50	36.10	11.40	1.00	0.20	93.90	528,222
1955	-	0.02	2.80	27.80	36.30	21.30	3.00	0.38	91.60	523,460
1956	-	0.03	6.94	43.08	34.58	8.84	0.94	0.19	94.60	539,089
1957	-	0.10	6.10	24.10	28.60	9.40	1.00	0.10	69.34	239,809

	Grade												Total White and Extra White	
Year	SGM	GM	SM	M+	M	SLM+	SLM	LM+	LM	SGO+	SGO	GO+	GO	
	Per cent	Per cent	Per cent	Per cent	Per cent	Per cent	Per cent	Per cent	Per cent	Per cent	Per cent	Per cent	Per cent	Per cent	Bales
1958	-	**	4.9	0.2	27.3	0.9	29.8	1.3	13.3	**	1.2	-	0.2	79.1	231,671
1959	-	**	5.2	2.1	35.1	6.9	33.3	3.3	6.6	0.1	0.5	**	**	93.2	453,830
1960	-	**	5.8	0.7	29.3	3.1	34.8	2.7	9.0	0.1	0.9	**	**	86.4	429,073

*Less than 0.01 per cent.

**Less than 0.05 per cent.

1/ Running bales - linters excluded.

2/ Includes .01 per cent M.F.

3/ Includes .01 per cent M.F.

Source: 1928-37 - Grade, Staple Length, and Tenderability of Cotton in United States, 1928-29 to 1937-38, USDA, BAE, October, 1938.

1938 - Grade, Staple Length, and Tenderability of Cotton in United States, 1938-39, USDA, AMS, January, 1940.

1939-60 - Cotton Quality Statistics, United States, USDA, PMA, Cotton Branch.

Table 6.—Spotted Cotton Ginned in Louisiana, 1928-60[1/]

	Grade					Total Spotted	
Year	GM	SM	M	SLM	LM		
	Per cent	Per cent	Per cent	Per cent	Per cent	Per cent	Bales
1928	0.54	1.53	1.30	0.30	0.09	3.76	25,800
1929	0.18	1.53	1.27	0.24	0.01	3.22	25,700
1930	0.46	1.72	1.33	0.38	0.07	3.96	27,900
1931	0.47	1.90	0.65	0.13	0.15	3.30	28,900
1932	1.26	3.12	1.12	0.10	0.02	5.62	33,700
1933	1.53	13.13	8.63	0.96	0.15	24.40	114,500
1934	1.01	6.13	3.13	0.38	0.02	10.67	50,500
1935	0.11	5.65	3.38	0.33	0.02	9.49	51,400
1936	0.69	7.99	5.14	0.39	0.01	14.22	105,600
1937	0.35	10.09	10.15	2.95	0.42	23.96	251,700
1938	1.42	22.16	18.65	2.93	0.11	45.27	294,977
1939	0.59	13.93	11.96	0.37	0.01	26.96	192,802
1940	*	0.55	1.34	0.17	*	2.06	9,263
1941	0.09	12.01	7.42	0.59	0.02	20.13	62,499
1942	0.07	5.29	1.45	0.10	*	6.91	39,541
1943	0.01	0.94	0.99	0.35	0.03	2.33	16,585
1944	-	0.45	0.75	0.08	0.06	1.34	7,956
1945	0.01	1.89	2.74	0.60	0.46	5.70	21,540
1946	0.37	5.33	2.85	0.66	0.17	9.38	23,150
1947	0.07	2.51	3.71	0.79	0.12	7.20	35,260
1948	*	0.09	0.29	0.22	0.10	0.70	5,123
1949	0.01	0.67	1.28	0.92	0.33	3.23	20,460
1950	0.07	2.48	2.11	0.42	0.01	5.10	21,495
1951	0.02	1.16	2.80	1.01	0.45	5.64	42,307
1952	0.42	1.19	1.15	0.52	0.43	3.61	26,589
1953	0.04	0.32	0.76	0.57	0.44	2.13	16,943
1954	0.01	1.20	2.70	1.20	0.30	5.40	29,875
1955	*	0.70	3.30	2.70	1.30	8.00	46,254
1956	0.01	1.15	2.02	0.98	0.51	4.70	26,670
1957	-	0.70	6.20	14.00	8.60	29.50	102,230

(Continued)

Table 6.— (Continued)

	Grade									Total Light	
	Light Spot										
Year	GM	SM	M	SLM	LM	Light Spot		All Grades		Spot & Spotted	
	Per cent	Per cent	Per cent	Per cent	Per cent	Per cent	Bales	Per cent	Bales	Per cent	Bales
1958	**	0.60	5.50	6.10	3.80	16.00	46,865	1.50	4,252	17.50	51,108
1959	**	0.60	2.20	1.40	0.30	4.50	22,001	0.30	980	4.70	22,981
1960	**	0.40	4.00	4.20	1.20	9.80	48,558	0.60	2,901	10.40	51,459

*Less than 0.01 per cent.

**Less than 0.05 per cent.

1/Running bales - linters excluded.

Source: 1928-37 - Grade, Staple Length, and Tenderability of Cotton in United States, 1928-29 to 1937-38, USDA, BAE, October, 1938.

1938 - Grade, Staple Length, and Tenderability of Cotton in United States, 1938-39, USDA, AMS, January, 1940.

1939-60 - Cotton Quality Statistics, United States, USDA, PMA, Cotton Branch.

Table 7.— Tinged, Yellow Stained, Gray, and Below Grade Cotton Ginned in Louisiana, 1928-60[1]

Year	Tinged					Yellow Stained	Gray	Below Grade	Total Tinged, Yellow Stained, Gray, and Below Grade	
	Grade									
	GM	SM	M	SLM	LM					
	Per cent	Per cent	Per cent	Per cent	Per cent	Per cent	Per cent	Per cent	Per cent	Bales
1928	0.02	-	-	-	-	-	0.04	0.13	0.19	1,300
1929	-	0.01	0.01	-	-	0.03[2]	0.13	0.13[3]	0.30	2,400
1930	0.02	0.07	0.01	-	-	-	0.16	0.34[4]	0.60	4,200
1931	-	-	-	-	-	-	0.26	0.39	0.65	5,700
1932	-	0.15	-	-	-	-	0.07	0.11	0.33	2,000
1933	-	-	-	-	-	-	-	0.06	0.06	300
1934	-	0.02	-	-	-	-	0.07	-	0.09	400
1935	-	-	-	-	-	-	0.02	-	0.02	100
1936	-	-	0.02	-	-	-	0.07	0.01	0.10	700
1937	-	0.01	-	-	0.01	-	-	0.13	0.15	1,600
1938	0.03	0.04	0.02	*	-	-	0.01	0.04	0.14	924
1939	-	*	-	-	-	-	0.09	0.01	0.10	686
1940	-	0.01	0.01	-	-	-	-	0.05	0.07	309
1941	-	-	-	-	-	-	-	0.17	0.17	518
1942	-	-	-	-	-	-	-	0.26	0.26	1,474
1943	-	-	-	-	-	-	-	0.02	0.02	192
1944	-	-	-	-	-	-	-	-	-	-
1945	-	-	-	-	0.02	-	0.11	0.06	0.19	170
1946	-	-	-	-	-	-	0.66	0.01	0.67	1,650
1947	-	0.01	*	*	-	-	0.04	0.01	0.06	290
1948	-	-	-	*	-	-	0.07	0.01	0.08	580
1949	-	-	*	-	-	-	0.38	0.04	0.43	2,740

(Continued)

Table 7.— (Continued)

Year	Tinged					Yellow:		Below:	Total Tinged, Yellow Stained, Gray, and Below Grade	
	Grade									
	GM	SM	M	SLM	LM	Stained	Gray	Grade		
	Per cent	Per cent	Per cent	Per cent	Per cent	Per cent	Per cent	Per cent	Per cent	Bales
1950	-	-	-	-	-	-	0.73	*	0.74	3,116
1951	-	-	-	-	-	-	0.13	*	0.14	1,059
1952	-	-	-	-	-	-	0.15	*	0.16	1,170
1953	-	*	0.01	0.09	0.08	-	0.31	0.01	0.50	3,999
1954	-	-	-	-	-	-	0.60	0.10	0.70	3,496
1955	-	-	-	*	0.01	-	0.20	0.17	0.38	2,186
1956	-	-	-	-	-	-	0.62	0.10	0.72	4,080
1957	-	-	-	0.30	0.10	-	0.40	0.30	1.10	3,792

Year	Tinged	Yellow: Stained	Gray	Light: Grey	Below: Grade	Total	
	Per cent	Per cent	Per cent	Per cent	Per cent	Per cent	Bales
1958	**	-	1.50	1.00	0.90	3.40	10,090
1959	**	**	1.90	0.10	**	2.10	10,132
1960	**	-	2.70	0.40	0.10	3.20	15,880

*Less than 0.01 per cent.

**Less than 0.05 per cent.

[1] Running bales - linters excluded.

[2] Includes .01 per cent classified as "light yellow tinged."

[3] Includes .05 per cent classified as "blue stained."

[4] Includes .03 per cent classified as "blue stained."

Source: 1928-37 - Grade, Staple Length, and Tenderability of Cotton in the United States, 1928-29 to 1937-38, USDA, BAE, October, 1938.

1938 - Grade, Staple Length, and Tenderability of Cotton in the United States, 1938-39, USDA, AMS, January, 1940.

1939-60 - Cotton Quality Statistics, United States, USDA, PMA, Cotton Branch.

Table 8.—Grade of Upland Cotton Ginned in Louisiana, by Periods, 1939-60[1/]

Ginning period	White				Spotted	Other	Total	
	SM & better	M	SLM	Below SLM	All grades	All grades	All grades	
	Per cent	Per cent	Per cent	Per cent	Per cent	Per cent	Bales	Per cent
Prior to September								
1939	39.00	44.40	8.80	1.80	5.80	*	150,809	100
1940	14.60	56.00	21.10	4.40	2.50	1.40	4,120	100
1941	30.80	49.00	18.00	1.80	0.20	0.20	27,084	100
1942	10.70	34.30	42.70	10.80	-	1.50	60,115	100
1943	39.79	46.92	11.46	1.60	0.21	0.02	214,137	100
1944	27.17	41.46	28.65	2.60	0.12	-	63,532	100
1945	4.98	34.45	41.33	18.60	0.64	-	21,884	100
1946	10.15	58.90	27.49	3.17	0.29	-	20,798	100
1947	29.26	59.36	10.20	1.05	0.13	-	68,547	100
1948	39.70	56.80	3.20	0.20	0.10	-	187,950	100
1949	4.60	68.90	24.30	1.90	0.20	0.02	63,429	100
1950	12.30	79.10	8.00	0.50	0.20	-	42,333	100
1951	21.10	64.00	11.90	0.30	1.60	0.10	170,831	100
1952	36.30	49.90	12.80	0.60	0.30	0.10	111,658	100
1953	31.20	49.10	17.00	2.10	0.20	0.40	30,217	100
1954	22.20	56.00	20.30	1.10	0.40	-	82,601	100
1955	3.60	42.70	42.60	10.30	0.60	0.20	43,471	100
1956	8.50	63.00	25.10	0.60	1.60	1.20	88,238	100
1957	41.17	51.89	5.83	0.02	0.09	-	29,660	100
1958	24.10	47.70	18.30	0.40	3.00	6.50	25,745	100
1959	21.40	53.00	12.80	0.60	1.60	10.60	12,799	100
1960	10.80	50.00	23.50	1.80	4.10	9.80	8,267	100

(Continued)

Table 8.— (Continued)

Ginning period	White				Spotted	Other	Total	
	SM & better	M	SLM	Below SLM	All grades	All grades	All grades	
	Per cent	Per cent	Per cent	Per cent	Per cent	Per cent	Bales	Per cent
During September								
1939	13.20	37.20	15.80	1.10	32.60	*	419,052	100
1940	15.80	47.40	32.50	3.10	1.10	0.10	204,173	100
1941	3.70	27.60	47.00	9.80	11.70	0.20	181,058	100
1942	8.80	40.60	41.10	6.70	2.60	0.20	292,759	100
1943	15.53	41.51	34.44	5.91	2.57	0.04	279,346	100
1944	3.67	35.73	55.07	4.93	0.60	-	254,892	100
1945	10.01	47.98	29.95	11.26	0.79	0.01	170,551	100
1946	6.17	41.15	43.90	1.68	6.89	0.21	132,835	100
1947	39.25	48.72	8.05	0.29	3.69	*	237,399	100
1948	25.80	55.30	15.70	2.70	0.40	0.10	280,403	100
1949	13.70	56.90	27.30	1.10	0.90	0.03	285,025	100
1950	13.50	57.50	23.80	2.00	2.30	0.90	174,320	100
1951	7.70	38.80	41.50	8.00	3.90	0.10	264,624	100
1952	29.10	51.70	16.80	1.70	0.70	*	352,929	100
1953	24.10	40.60	27.30	6.70	0.30	*	264,024	100
1954	12.70	45.20	35.20	3.30	3.30	0.30	255,062	100
1955	5.00	39.70	32.90	19.50	2.70	0.20	212,592	100
1956	9.00	46.00	34.80	5.60	4.40	0.20	285,918	100
1957	8.19	42.77	36.67	3.06	9.24	0.40	67,463	100
1958	5.90	36.40	24.50	8.20	16.00	9.00	46,325	100
1959	8.70	52.30	28.50	3.60	2.30	4.60	155,955	100
1960	12.20	50.20	24.60	2.80	3.50	6.70	145,315	100

(Continued)

Table 8.— (Continued)

	White				Spotted	Other	Total	
Ginning period	SM & better	M	SLM	Below SLM	All grades	All grades	All grades	
	Per cent	Per cent	Per cent	Per cent	Per cent	Per cent	Bales	Per cent
During October								
1939	2.70	11.50	46.80	6.10	32.60	0.20	136,586	100
1940	2.10	39.30	51.90	4.80	1.90	-	197,555	100
1941	0.70	6.90	39.10	11.00	42.30	-	89,796	100
1942	3.50	34.50	43.20	4.60	14.20	-	192,488	100
1943	1.18	10.43	51.04	33.50	3.85	*	152,886	100
1944	0.74	39.18	53.92	4.55	1.61	-	195,351	100
1945	1.01	22.32	57.34	12.11	7.16	0.06	109,407	100
1946	0.65	17.01	56.21	11.40	13.10	1.63	74,973	100
1947	2.61	45.20	35.38	2.00	14.78	0.03	143,699	100
1948	11.50	42.60	37.80	7.60	0.50	*	193,922	100
1949	1.70	22.80	49.20	22.00	3.80	0.50	146,838	100
1950	5.10	46.60	37.90	4.90	4.80	0.70	149,189	100
1951	1.80	15.50	48.50	26.90	7.10	0.20	234,178	100
1952	16.70	48.00	28.60	3.50	3.20	*	212,537	100
1953	13.30	43.20	32.10	10.00	1.20	0.20	305,420	100
1954	2.00	19.40	47.00	21.30	9.30	1.00	164,104	100
1955	1.20	21.40	41.30	25.60	10.20	0.30	220,938	100
1956	4.20	35.00	38.10	16.40	5.20	1.10	151,409	100
1957	2.60	25.70	41.50	12.18	17.60	0.36	134,800	100
1958	2.00	19.80	34.00	19.00	22.60	2.60	146,090	100
1959	3.70	33.80	47.90	10.70	3.70	0.20	220,611	100
1960	5.10	29.40	43.70	12.90	7.70	1.20	190,697	100

(Continued)

Table 8.— (Continued)

Ginning period	White				Spotted	Other	Total	
	SM & better	M	SLM	Below SLM	All grades	All grades	All grades	
	Per cent	Per cent	Per cent	Per cent	Per cent	Per cent	Bales	Per cent
During November								
1939	*	7.70	46.30	20.50	22.20	3.20	10,382	100
1940	1.70	33.90	49.20	7.20	8.00	-	34,650	100
1941	0.10	4.70	55.90	15.10	24.20	-	11,059	100
1942	1.40	15.30	49.00	17.50	16.80	-	25,114	100
1943	0.98	7.08	36.99	49.75	4.55	0.05	50,075	100
1944	0.11	14.67	67.68	14.55	2.99	-	57,186	100
1945	0.09	2.87	46.74	34.40	15.61	0.29	58,116	100
1946	0.14	6.41	41.72	30.02	21.00	0.71	14,191	100
1947	0.86	19.39	40.01	24.67	14.94	0.13	23,222	100
1948	1.50	12.10	50.00	34.30	1.90	0.20	40,268	100
1949	0.30	7.20	40.10	43.70	7.00	1.60	118,461	100
1950	0.10	14.30	49.70	18.30	17.00	0.60	49,809	100
1951	0.30	6.70	39.50	40.70	12.60	0.20	66,164	100
1952	4.80	31.40	34.60	8.50	19.70	1.00	47,154	100
1953	2.00	21.80	41.20	32.00	2.40	0.60	157,682	100
1954	0.40	9.50	36.30	42.00	10.00	1.80	55,387	100
1955	1.00	19.40	31.80	39.50	16.80	0.50	79,184	100
1956	0.30	14.80	44.00	31.30	8.10	1.50	35,421	100
1957	0.27	8.44	28.84	17.93	43.42	1.01	49,665	100
1958	4.50	32.00	32.00	19.70	11.30	0.50	53,061	100
1959	1.00	20.70	47.10	21.20	9.00	1.00	83,260	100
1960	0.30	13.00	51.20	20.90	13.00	1.60	115,405	100

(Continued)

Table 8.— (Continued)

Ginning period	White: SM & better	White: M	White: SLM	White: Below SLM	Spotted: All grades	Other: All grades	Total: All grades	
	Per cent	Per cent	Per cent	Per cent	Per cent	Per cent	Bales	Per cent
After November								
1939	-	21.20	47.10	2.90	28.80	-	1,092	100
1940	0.60	15.80	39.30	39.90	4.40	-	8,498	100
1941	-	1.10	20.30	39.40	39.20	-	1,478	100
1942	0.40	8.20	57.20	13.20	21.00	-	1,859	100
1943	0.93	4.08	20.62	69.46	4.91	-	16,080	100
1944	-	4.48	39.05	49.97	6.50	-	23,158	100
1945	0.11	5.24	33.30	41.01	17.75	2.59	17,750	100
1946	-	3.82	18.22	47.64	29.05	1.27	3,925	100
1947	0.35	8.28	16.97	63.09	10.07	1.24	16,975	100
1948	0.30	2.80	10.60	78.20	7.10	1.00	30,151	100
1949	0.10	3.60	32.00	45.40	18.30	0.50	19,863	100
1950	-	4.10	37.80	26.10	31.20	0.90	6,112	100
1951	0.20	2.60	27.20	41.30	30.70	-	13,429	100
1952	2.30	13.00	15.40	14.90	53.50	0.90	14,324	100
1953	1.00	8.20	22.90	44.20	17.70	6.00	37,930	100
1954	1.00	5.00	24.00	59.70	8.00	2.30	4,439	100
1955	-	5.40	17.20	43.50	29.90	4.00	15,715	100
1956	0.20	2.90	24.30	49.20	20.10	3.30	8,853	100
1957	0.10	0.34	3.56	13.15	78.51	4.32	64,253	100
1958	0.80	25.30	32.80	22.20	17.90	1.00	21,648	100
1959	0.20	8.60	33.80	30.40	25.00	2.00	14,318	100
1960	0.20	2.50	22.00	27.50	44.50	3.30	36,728	100

*Less than .01 per cent.

1/Running bales - linters excluded.

Source: Cotton Quality Statistics, United States, USDA, PMA, Cotton Branch.

Table 9.— Grade of Upland Cotton Ginned in Louisiana, in District 1, 1943-60[1]

	White				Spotted		Other[2]		Total	
	M and better		Below M		All grades		All grades		All grades	
Year	Bales	Per cent	Bales	Per cent	Bales	Per cent	Bales	Per cent	Bales	Per cent
1943	68,936	44.45	79,636	51.35	6,448	4.16	65	0.04	155,085	100
1944	34,383	29.02	79,195	66.86	4,879	4.12	-	-	118,457	100
1945	22,670	26.76	55,632	65.67	6,180	7.29	240	0.28	84,722	100
1946	12,790	20.62	43,733	70,51	5,500	8.87	-	-	62,023	100
1947	60,599	48.70	36,900	29.65	26,870	21.59	80	0.06	124,449	100
1948	107,201	56.40	80,462	42.34	2,247	1.18	151	0.08	190,061	100
1949	40,795	22.28	127,010	69.38	13,462	7.35	1,799	0.98	183,066	100
1950	34,903	29.29	69,973	58.72	11,432	9.59	2,853	2.39	119,161	100
1951	42,483	23.20	114,529	62.20	25,244	13.80	715	0.40	182,971	100
1952	102,797	52.20	71,201	36.10	22,943	11.60	92	0.10	197,033	100
1953	85,139	40.60	117,431	56.00	6,126	2.90	1,170	0.50	209,866	100
1954	43,960	36.85	63,842	53.52	10,283	8.62	1,207	1.01	119,292	100
1955	19,794	15.47	83,239	65.05	23,863	18.65	1,071	0.83	127,967	100
1956	44,207	43.00	46,207	44.90	11,005	10.70	1,423	1.40	102,842	100
1957	11,458	14.64	32,770	41.87	32,659	41.73	1,370	1.75	78,257	100
1958	15,412	21.28	39,279	54.23	16,171	22.33	1,565	2.16	72,427	100
1959	59,352	44.79	64,031	48.32	8,670	6.54	462	0.35	132,515	100
1960	38,178	30.38	72,521	57.71	13,378	10.65	1,581	1.26	125,658	100

[1] Running bales - linters excluded.

[2] Includes Tinged, Yellow, Gray, and Below Grade.

Source: 1943-60 - Cotton Quality Statistics, United States, USDA, PMA, Cotton Branch.

Table 10.— Grade of Upland Cotton Ginned in Louisiana, in District 2, 1943-60[1]

	White				Spotted		Other[2]		Total	
	M and better		Below M		All grades		All grades		All grades	
Year	Bales	Per cent	Bales	Per cent	Bales	Per cent	Bales	Per cent	Bales	Per cent
1943	40,651	60.65	23,614	35.24	2,756	4.11	-	-	67,021	100
1944	24,592	54.90	19,824	44.25	379	0.85	-	-	44,795	100
1945	9,640	38.36	13,162	52.37	2,330	9.27	-	-	25,132	100
1946	5,020	26.30	11,944	62.59	2,100	11.00	20	0.11	19,084	100
1947	18,813	73.29	4,310	16.78	2,550	9.93	-	-	25,673	100
1948	29,937	85.19	5,140	14.63	65	0.18	-	-	35,142	100
1949	27,964	54.37	22,815	44.36	532	1.03	119	0.23	51,430	100
1950	2,121	13.73	9,723	62.94	3,501	22.66	104	0.67	15,449	100
1951	7,526	31.00	14,482	59.70	2,243	9.30	-	-	24,251	100
1952	16,785	76.10	4,929	22.40	332	1.50	-	-	22,046	100
1953	18,144	80.80	4,189	18.60	138	0.60	-	-	22,469	100
1954	8,609	57.41	5,717	38.10	668	4.50	-	-	14,994	100
1955	9,947	44.86	11,257	50.76	964	4.34	10	0.04	22,178	100
1956	9,384	63.30	3,849	26.00	1,590	10.70	-	-	14,823	100
1957	2,157	26.92	3,885	48.48	1,950	24.33	20	0.24	8,012	100
1958	75	2.81	696	26.10	1,886	70.72	10	0.37	2,667	100
1959	1,291	38.85	1,194	35.93	830	24.98	8	0.24	3,323	100
1960	343	14.34	1,231	51.49	817	34.17	-	-	2,391	100

[1] Running bales - linters excluded.

[2] Includes Tinged, Yellow, Gray, and Below Grade.

Source: 1943-60 - Cotton Quality Statistics, United States, USDA, PMA, Cotton Branch.

Table 11.— Grade of Upland Cotton Ginned in Louisiana, in District 3, 1943-60[1]

	White				Spotted		Other[2]		Total	
	M and better		Below M		All grades		All grades		All grades	
Year	Bales	Per cent	Bales	Per cent	Bales	Per cent	Bales	Per cent	Bales	Per cent
1943	138,112	50.03	136,902	49.59	1,037	0.37	22	0.01	276,073	100
1944	109,239	44.92	133,389	54.85	558	0.23	-	-	243,186	100
1945	65,720	42.14	80,323	51.51	9,480	6.08	420	0.27	155,943	100
1946	43,080	43.54	42,865	43.33	11,360	11.48	1,630	1.65	98,935	100
1947	154,019	75.63	47,600	23.37	1,820	0.90	210	0.10	203,649	100
1948	229,769	72.80	84,701	26.83	904	0.29	263	0.08	315,637	100
1949	148,370	56.57	110,457	42.12	2,977	1.14	468	0.18	262,272	100
1950	127,460	69.06	52,112	28.24	4,910	2.66	77	0.04	184,559	100
1951	137,921	45.70	155,938	51.60	7,760	2.70	231	*	301,850	100
1952	274,599	88.00	35,640	11.40	1,063	0.30	888	0.30	312,190	100
1953	250,058	66.90	115,187	30.80	6,379	1.70	2,168	0.20	413,792	100
1954	100,898	40.78	127,193	51.40	17,105	6.92	2,261	0.90	247,457	100
1955	115,608	41.56	150,105	53.97	11,610	4.17	844	0.30	278,167	100
1956	144,835	50.64	132,162	46.21	8,049	2.82	944	0.33	285,990	100
1957	66,163	32.33	73,705	39.61	49,998	26.87	2,192	1.10	186,058	100
1958	53,792	35.26	79,245	51.94	18,656	12.23	881	0.58	152,574	100
1959	94,036	36.13	156,594	60.17	8,378	3.22	1,258	0.48	260,266	100
1960	83,529	30.99	149,976	55.65	32,975	12.23	3,058	1.13	269,538	100

*Less than 0.01 per cent.

[1] Running bales - linters excluded.

[2] Includes Tinged, Yellow, Gray, and Below Grade.

Source: 1943-60 - Cotton Quality Statistics, United States, USDA, PMA, Cotton Branch.

Table 12.—Grade of Upland Cotton Ginned in Louisiana, in District 4, 1943-60[1]

Year	White				Spotted		Other[2]		Total	
	M and better		Below M		All grades		All grades		All grades	
	Bales	Per cent	Bales	Per cent	Bales	Per cent	Bales	Per cent	Bales	Per cent
1943	120,217	56.08	87,679	40.91	6,344	2.96	105	0.05	214,345	100
1944	63,301	33.73	122,240	65.13	2,140	1.14	-	-	187,681	100
1945	37,700	33.69	70,611	63.10	3,550	3.17	50	0.04	111,911	100
1946	30,650	45.96	31,840	47.75	4,190	6.29	-	-	66,680	100
1947	111,021	81.59	21,030	15.46	4,020	2.95	-	-	136,071	100
1948	153,353	79.93	36,428	18.99	1,907	0.99	166	0.09	191,854	100
1949	76,421	55.84	56,584	41.35	3,489	2.55	354	0.26	136,848	100
1950	82,456	80.37	18,404	17.94	1,652	1.61	82	0.08	102,594	100
1951	126,932	52.90	106,049	44.20	7,060	2.90	113	*	240,154	100
1952	144,492	69.70	60,400	29.10	2,251	1.10	190	0.10	207,333	100
1953	55,786	37.50	88,399	59.40	4,300	2.90	274	0.20	148,759	100
1954	99,916	40.80	78,087	51.40	1,819	6.90	28	0.90	179,850	100
1955	29,557	20.58	103,953	72.39	9,817	6.83	261	0.20	143,588	100
1956	86,803	52.23	71,642	43.11	6,026	3.63	1,713	1.03	166,184	100
1957	30,918	42.05	24,753	33.67	17,623	23.97	220	0.29	73,514	100
1958	25,594	39.25	17,578	26.96	14,395	22.08	7,634	11.71	65,201	100
1959	52,172	57.43	25,160	27.70	5,103	5.60	8,404	9.25	90,839	100
1960	55,665	56.33	27,630	27.96	4,289	4.34	11,241	11.37	98,825	100

*Less than 0.01 per cent.

[1] Running bales - linters excluded.

[2] Includes Tinged, Yellow, Gray, and Below Grade.

Source: 1943-60 - Cotton Quality Statistics, United States, USDA, PMA, Cotton Branch.

Table 13.— Staple Length of Upland Cotton Ginned in Louisiana, 1928-60[1]

Year	15/16" and shorter[2] .9375	31/32" and 1"	1-1/32" and 1-1/16"	1-3/32" and 1-1/8"	1-5/32" and longer 1.16	Total all lengths	
	Per cent	Per cent	Per cent	Per cent	Per cent	Bales	Per cent
1928	68.60	18.60	7.60	4.00	1.20	685,900	100
1929	66.40	21.30	8.00	3.70	0.60	797,700	100
1930	59.50	26.50	9.50	4.00	0.50	704,800	100
1931	47.80	32.30	15.20	4.00	0.60	876,600	100
1932	57.60	26.10	11.50	4.40	0.40	599,500	100
1933	48.30	27.80	15.30	8.20	0.40	469,300	100
1934	58.90	21.50	14.40	4.80	0.30	473,300	100
1935	44.50	31.20	15.90	8.20	0.20	541,400	100
1936	32.70	32.50	23.90	8.60	2.30	742,600	100
1937	49.70	37.10	11.20	1.80	0.20	1,050,600	100
1938	7.60	26.40	42.80	20.10	3.10	651,537	100
1939	11.10	34.10	44.70	9.10	1.00	717,921	100
1940	3.30	37.30	57.30	2.00	0.10	448,996	100
1941	4.20	27.30	61.80	6.10	0.50	310,475	100
1942	9.20	41.80	43.30	4.50	1.20	572,335	100
1943	15.20	41.70	35.80	5.60	1.70	712,524	100
1944	5.90	54.40	31.10	7.40	1.20	594,119	100
1945	1.10	12.40	72.80	13.30	0.40	377,708	100
1946	0.70	14.00	77.30	7.50	0.50	246,722	100
1947	3.10	22.10	66.50	8.20	0.10	489,842	100
1948	1.52	10.54	74.66	13.23	0.05	732,694	100
1949	0.48	4.12	76.62	18.37	0.41	633,616	100

(Continued)

Table 13.— (Continued)

Year	15/16" and shorter[2]	1/32": and 1"	1-1/32" and 1-1/16"	1-3/32" and 1-1/8"	1-5/32" and longer	Total and lengths	
	Per cent	Per cent	Per cent	Per cent	Per cent	Bales	Per cent
1950	0.31	1.05	77.14	21.29	0.21	421,763	100
1951	0.41	4.18	83.21	12.09	0.11	749,226	100
1952	0.24	3.72	88.93	7.10	0.01	738,602	100
1953	0.80	4.00	85.20	10.00	*	795,273	100
1954	6.60	17.24	70.30	5.80	0.06	561,593	100
1955	0.31	2.77	88.72	8.16	0.04	571,900	100
1956	1.20	7.77	86.60	4.43	*	569,839	100
1957	0.37	3.36	93.60	2.65	-	345,841	100
1958	1.18	7.77	86.40	4.64	*	292,869	100
1959	0.04	1.21	95.19	3.56	-	486,943	100
1960	0.40	6.00	90.00	3.60	-	496,412	100

*Less than 0.01 per cent.

[1] Running bales - linters excluded.

[2] Includes all bales for which no specific length is assigned because of character defects.

Sources: 1928-37 - Grade, Staple Length and Tenderability of Cotton in the United States, USDA, BAE, October 1938.
1938 - Grade, Staple Length and Tenderability of Cotton in the United States, USDA, AMS, January 1940.
1939-60 - Cotton Quality Statistics, United States, USDA, PMS, Cotton Branch.

Table 14.—Staple Length of Upland Cotton Ginned in Louisiana, 1938-60[1]

Year	13/16" and shorter[2]	7/8"	29/32"	15/16"	31/32"	1"	1-1/32"	1-1/16"
				Bales				
1938[3]	4,305	10,559	9,209	25,724	60,367	111,507	128,031	150,234
1939	4,154	14,184	19,650	41,471	83,287	161,807	198,954	123,116
1940	635	1,363	2,306	10,547	30,299	137,243	179,852	77,169
1941	179	2,667	2,342	7,687	19,628	65,181	90,105	102,084
1942	1,579	9,458	11,206	29,939	65,051	174,290	173,624	74,413
1943	2,250	14,348	31,941	60,025	102,868	193,613	171,881	83,597
1944	977	3,389	5,010	25,436	84,554	238,489	126,696	57,992
1945	260	1,050	510	2,250	2,640	44,130	124,490	150,668
1946	30	340	420	920	2,540	32,040	99,942	90,660
1947	870	3,400	3,210	7,750	21,860	86,290	174,752	150,500
1948	496	1,929	1,768	6,947	9,379	67,803	241,404	305,652
1949	198	785	380	1,673	1,962	24,140	167,853	317,644
1950	7	377	134	808	353	4,066	64,202	261,151
1951	69	637	370	2,020	1,723	29,585	197,100	426,356
1952	29	517	90	1,661	2,083	24,449	205,649	451,597
1953	-	425	412	2,270	3,563	29,903	194,638	483,440
1954	99	4,472	7,080	25,504	25,646	71,156	196,347	198,546
1955	10	515	213	1,083	950	14,938	143,546	363,912
1956	-	905	1,054	4,911	3,306	41,004	217,093	276,308
1957	-	297	91	894	1,196	10,442	108,620	215,113
1958	-	341	112	3,017	1,623	21,173	112,846	140,180
1959	-	-	21	185	175	5,707	139,961	323,577
1960	10	84	306	1,400	2,292	27,315	208,335	238,986

(Continued)

Table 14.— (Continued)

Year	1-3/32"	1-1/8"	1-5/32"	1-3/16"	1-7/32"	1-1/4" and longer	Total all lengths
				Bales			
1938	96,428	34,802	12,201	5,138	2,097	935	651,537
1939	48,470	16,473	4,117	1,226	414	598	717,921
1940	7,306	1,704	462	73	25	12	448,996
1941	15,906	3,062	700	234	285	415	310,475
1942	17,783	8,067	3,021	1,458	1,101	1,345	572,335
1943	26,019	13,730	6,857	3,033	1,442	920	712,524
1944	27,683	16,160	4,802	1,904	789	238	594,119
1945	42,620	7,400	900	390	230	170	377,708
1946	16,310	2,130	600	360	260	170	246,722
1947	34,480	6,970	600	50	70	40	489,842
1948	90,517	6,404	170	156	40	29	732,694
1949	102,757	13,612	1,923	433	104	152	633,616
1950	83,493	6,292	399	210	219	52	421,763
1951	82,998	7,650	591	96	20	11	749,226
1952	51,184	1,284	59	-	-	-	738,602
1953	75,872	4,177	518	26	-	29	795,273
1954	29,190	3,190	329	34	-	-	561,593
1955	45,431	1,167	35	-	-	-	571,900
1956	24,235	1,013	10	-	-	-	569,839
1957	9,060	128	-	-	-	-	345,841
1958	13,073	512	8	-	-	20	292,869
1959	16,930	387	-	-	-	-	486,943
1960	17,203	481	-	-	-	-	496,412

---

[1] Running bales - linters excluded.

[2] Includes all bales for which no specific length is assigned because of character defect.

[3] Staple lengths of upland cotton prior to 1938 given only in 16th inches. See table 13.

Sources: 1938 - Grade, Staple Length and Tenderability of Cotton in the United States, USDA, AMS, January 1940.
1938-60 - Cotton Quality Statistics, United States, USDA, PMA, Cotton Branch.

Table 15.—Staple Length of Upland Cotton Ginned in Louisiana, Per Cent of Total, by Ginning Periods, 1938-60[1]

Ginning period	Shorter than 7/8"[2]	7/8" & 29/32"	15/16" & 31/32"	1" & 1-1/32"	1-1/16" & 1-3/32"	1-1/8" & 1-5/32"	1-3/16 & 1-7/32"	1-1/4" & longer	Total all lengths	
	Per cent	Per cent	Per cent	Per cent	Per cent	Per cent	Per cent	Per cent	Per cent	1,000 Bales
Prior to October 1										
1938	0.6	2.5	11.0	35.2	40.8	8.3	1.4	0.2	100	514.4
1939	0.5	3.7	14.1	52.9	25.7	2.8	0.2	0.1	100	569.9
1940	0.2	1.1	11.2	69.1	17.8	0.6	-	-	100	208.2
1941	-	1.2	3.8	38.7	54.4	1.5	0.2	0.3	100	208.0
1942	0.3	3.5	13.1	61.2	19.1	2.2	0.3	0.3	100	352.6
1943	0.4	6.0	19.1	51.9	18.3	3.4	0.7	0.2	100	493.4
1944	0.1	1.5	20.0	57.0	16.1	4.7	0.5	0.1	100	318.4
1945	0.1	0.3	1.6	45.4	50.0	2.5	0.1	*	100	192.3
1946	-	0.1	0.7	54.3	43.1	1.4	0.3	0.1	100	153.5
1947	0.3	1.6	5.2	47.1	44.3	1.3	*	*	100	306.0
1948	0.1	0.5	2.1	39.8	58.4	1.1	*	*	100	468.4
1949	0.1	0.3	0.5	23.8	71.4	3.8	0.1	*	100	348.5
1950	*	*	*	4.4	93.4	2.1	0.1	*	100	216.7
1951	*	0.2	0.5	26.1	71.7	1.1	*	*	100	435.5
1952	*	0.1	0.3	21.3	76.2	2.1	-	-	100	473.5
1953	-	0.2	0.2	15.8	83.1	0.8	*	*	100	394.2
1954	*	1.0	4.7	42.3	51.3	0.7	*	-	100	255.0
1955	-	0.4	0.2	27.0	72.1	0.3	-	-	100	212.6
1956	-	0.4	1.0	46.3	52.1	0.2	-	-	100	374.2
1957	-	0.1	0.2	22.0	77.6	0.1	-	-	100	97.1
1958	-	*	1.0	49.1	49.9	*	-	-	100	72.1
1959	-	-	0.1	35.1	64.8	*	-	-	100	168.7
1960	*	0.2	1.5	57.9	40.2	0.2	-	-	100	153.6

(Continued)

Table 15.— (Continued)

Ginning period	Shorter than 7/8"[2]	7/8" & 29/32"	15/16" & 31/32"	1" & 1-1/32"	1-1/16" & 1-3/32"	1-1/8" & 1-5/32"	1-3/16 & 1-7/32"	1-1/4" & longer	Total all lengths	
	Per cent	Per cent	Per cent	Per cent	Per cent	Per cent	Per cent	Per cent	Per cent	1,000 Bales
During October										
1938	0.8	5.0	21.3	43.3	26.4	3.1	0.1	-	100	129.1
1939	0.8	9.2	29.4	39.9	17.3	3.1	0.2	0.1	100	136.6
1940	-	0.7	6.5	71.2	21.1	0.5	-	-	100	197.6
1941	0.1	2.4	17.1	74.5	5.2	0.4	0.2	0.1	100	89.8
1942	0.2	3.5	22.7	60.3	10.8	1.7	0.6	0.2	100	192.6
1943	0.2	7.5	28.1	51.6	10.0	2.0	0.5	0.1	100	152.9
1944	0.2	1.5	19.7	64.2	11.4	2.5	0.4	0.1	100	195.3
1945	0.1	0.6	1.3	40.2	54.8	2.6	0.3	0.1	100	109.6
1946	*	0.5	2.4	52.0	44.1	0.8	0.1	0.1	100	75.1
1947	*	1.0	7.5	62.8	26.9	1.7	0.1	-	100	143.6
1948	0.1	0.7	2.6	50.6	45.2	0.7	0.1	*	100	193.9
1949	*	0.1	0.4	21.4	76.5	1.5	0.1	*	100	146.8
1950	*	0.1	0.3	23.5	74.7	1.3	0.1	*	100	149.2
1951	-	0.1	0.7	36.8	62.7	0.7	*	-	100	234.2
1952	-	0.1	0.8	42.4	56.6	0.1	-	-	100	212.6
1953	-	0.1	1.1	30.9	68.8	0.1	-	-	100	305.3
1954	0.1	4.4	14.5	54.4	26.1	0.5	-	-	100	164.9
1955	*	0.2	0.3	28.1	71.3	0.1	-	-	100	220.9
1956	-	0.4	2.6	44.0	52.9	0.1	-	-	100	151.4
1957	-	*	0.2	30.3	69.4	*	-	-	100	134.8
1958	-	0.3	2.4	50.0	47.2	0.1	-	*	100	146.1
1959	-	*	0.1	21.6	78.2	0.1	-	-	100	220.6
1960	-	*	0.2	31.1	68.6	0.1	-	-	100	190.7

(Continued)

Table 15.— (Continued)

Ginning period	Shorter than 7/8"[2]	7/8" & 29/32"	15/16" & 31/32"	1" & 1-1/32"	1-1/16" & 1-3/32"	1-1/8" & 1-5/32"	1-3/16" & 1-7/32"	1-1/4" & longer	Total all lengths	
	Per cent	Per cent	Per cent	Per cent	Per cent	Per cent	Per cent	Per cent	Per cent	1,000 Bales
During November										
1938	*	4.4	20.6	35.3	35.3	4.4	-	*	100	6.8
1939	1.0	2.9	38.8	40.8	13.6	2.9	-	-	100	10.3
1940	*	0.8	12.1	75.3	11.8	-	*	-	100	34.7
1941	*	1.8	32.7	62.8	2.7	*	-	-	100	11.1
1942	*	5.6	18.3	59.0	16.3	0.4	0.4	*	100	25.2
1943	0.4	9.4	41.7	39.3	7.4	1.8	*	-	100	50.1
1944	0.7	0.5	9.4	73.9	13.6	1.6	0.3	-	100	57.3
1945	*	0.3	0.3	47.2	60.0	0.9	0.3	*	100	58.0
1946	-	2.1	2.8	50.0	45.1	*	-	-	100	14.2
1947	0.4	0.4	6.9	65.6	26.3	0.4	-	-	100	23.2
1948	-	*	1.2	56.9	41.4	0.5	-	-	100	40.3
1949	*	0.1	0.8	51.6	42.2	0.3	*	*	100	118.5
1950	*	0.4	0.8	47.3	56.1	0.4	*	*	100	49.8
1951	-	-	*	29.3	70.5	0.2	-	-	100	66.2
1952	-	*	1.3	59.9	38.8	*	-	-	100	47.1
1953	-	-	1.0	31.3	67.0	0.7	-	-	100	159.3
1954	-	1.7	19.1	58.0	21.0	0.2	-	-	100	55.4
1955	-	0.3	0.3	28.8	70.5	0.1	-	-	100	79.2
1956	-	0.3	0.7	42.5	56.5	-	-	-	100	35.4
1957	-	0.1	0.6	40.5	58.7	*	-	-	100	49.7
1958	-	0.1	0.2	27.6	71.5	0.6	-	-	100	53.1
1959	-	*	*	35.4	64.5	*	-	-	100	83.3
1960	-	0.1	0.5	54.2	45.2	-	-	-	100	115.4

(Continued)

Table 15.— (Continued)

Ginning period	Shorter than 7/8"[2]	7/8" & 29/32"	15/16" & 31/32"	1" & 1-1/32"	1-1/16 & 1-3/32"	1-1/8" & 1-5/32"	1-3/16" & 1-7/32"	1-1/4" & longer	Total all lengths	
	Per cent	Per cent	Per cent	Per cent	Per cent	Per cent	Per cent	Per cent	Per cent	1,000 Bales
After November 30										
1938	*	*	45.4	27.3	27.3	*	-	-	100	1.1
1939	*	10.0	40.0	50.0	*	-	*	*	100	1.1
1940	-	-	5.9	75.3	18.8	*	-	-	100	8.5
1941	*	*	20.0	80.0	*	-	-	-	100	1.6
1942	-	*	22.2	77.8	*	*	*	-	100	1.9
1943	*	4.3	30.4	63.4	1.9	*	-	-	100	16.1
1944	*	0.9	10.8	68.8	18.2	0.9	0.4	-	100	23.1
1945	-	*	1.1	54.8	43.0	1.1	*	-	100	17.8
1946	-	-	5.1	61.6	33.3	-	-	-	100	3.9
1947	-	*	7.1	69.2	23.7	*	-	-	100	17.0
1948	-	*	2.3	36.1	61.3	0.3	-	-	100	30.2
1949	*	*	1.5	53.8	44.7	*	*	*	100	19.9
1950	*	1.6	1.6	44.3	52.5	*	*	*	100	6.1
1951	-	-	0.5	54.6	44.9	-	-	-	100	13.4
1952	-	-	*	76.8	23.2	-	-	-	100	14.2
1953	-	-	0.2	46.7	52.8	0.3	*	-	100	37.9
1954	-	1.0	15.7	80.0	3.3	-	-	-	100	4.3
1955	-	0.1	0.7	37.5	61.7	-	-	-	100	15.7
1956	-	0.1	3.3	34.8	61.8	-	-	-	100	8.9
1957	-	0.3	2.2	57.0	40.5	-	-	-	100	64.3
1958	-	0.2	1.5	50.5	47.8	*	-	-	100	21.6
1959	-	-	0.2	64.9	34.9	-	-	-	100	11.3
1960	-	0.1	0.7	68.0	31.2	*	-	-	100	36.7

[1] Running bales - linters excluded.

[2] Includes all bales for which no specific length is assigned because of character defects.

* Less than .05 per cent.

Source: Cotton Quality Statistics, United States, USDA, PMA, Cotton Branch.

Table 16.—Staple Length of Upland Cotton Ginned in Louisiana, in District 1, 1939-60[1]

Year	Shorter than 7/8"[2]	7/8" and 29/32"	15/16" and 31/32"	1" and 1-1/32"	1-1/16" and 1-3/32"	1-1/8" and 1-5/32"	1-3/16" and 1-7/32"	1-1/4" and longer	All lengths	Average length
	Bales	Bales	Bales	Bales	Bales	Bales	Bales	Bales	Bales	32d. in.
1939	3,074	24,152	53,229	56,734	7,534	40	14	14	144,791	31.6
1940	138	1,102	13,703	105,659	24,825	116	-	-	145,543	32.6
1941	47	313	4,666	29,139	7,880	72	-	-	42,117	32.6
1942	59	3,151	19,226	76,515	9,435	685	105	14	109,190	32.2
1943	423	12,452	62,707	73,133	4,964	986	391	29	155,085	31.4
1944	85	932	16,742	96,055	4,432	155	50	6	118,457	32.1
1945	10	470	230	36,410	47,292	310	-	-	84,722	33.5
1946	-	10	30	15,923	46,040	20	-	-	62,023	33.8
1947	10	640	3,490	82,109	37,590	590	20	-	124,449	33.1
1948	8	229	2,685	119,378	67,544	217	-	-	190,061	33.2
1949	187	829	1,035	83,904	96,756	355	-	-	183,066	33.5
1950	7	297	480	24,585	93,565	227	-	-	119,161	33.9
1951	22	176	685	57,138	124,846	93	11	-	182,971	33.7
1952	-	39	313	76,732	119,878	71	-	-	197,033	33.6
1953	-	120	413	65,664	143,587	469	-	-	210,253	33.7
1954	9	735	3,916	87,590	27,025	18	-	-	119,292	32.9
1955	-	79	222	59,019	68,647	-	-	-	127,967	33.5
1956	-	502	2,773	69,064	30,503	-	-	-	102,842	33.1
1957	-	24	125	26,172	51,880	56	-	-	78,257	33.7
1958	-	115	318	42,467	29,487	20	-	20	72,427	33.3
1959	-	10	161	43,377	88,948	19	-	-	132,515	33.7
1960	-	99	883	67,579	57,067	30	-	-	125,658	33.4

[1] Running bales - linters excluded.

[2] Includes all bales for which no specific length is assigned because of character defects.

Source: Cotton Quality Statistics, United States, USDA, PMA, Cotton Branch.

Table 17.— Staple Length of Upland Cotton Ginned in Louisiana, in District 2, 1939-60[1]

Year	Shorter than 7/8"[2]	7/8" and 29/32"	15/16" and 31/32"	1" and 1-1/32"	1-1/16" and 1-3/32"	1-1/8" and 1-5/32"	1-3/16" and 1-7/32"	1-1/4" and longer	All lengths	Average length
	Bales	Bales	Bales	Bales	Bales	Bales	Bales	Bales	Bales	32d. in.
1939	39	482	7,392	56,596	17,929	295	-	-	82,733	33.3
1940	168	2,096	14,904	47,539	4,541	-	-	-	69,248	32.0
1941	59	4,077	14,890	13,075	375	-	-	-	32,476	31.0
1942	1,352	15,084	25,448	17,623	425	20	-	-	59,952	30.4
1943	1,572	28,288	32,637	4,123	101	300	-	-	67,021	29.7
1944	447	5,138	28,078	10,805	197	130	-	-	44,795	30.7
1945	210	900	2,190	18,880	2,702	110	140	-	25,132	32.4
1946	30	700	1,260	13,994	3,050	50	-	-	19,084	32.6
1947	780	5,480	8,090	10,493	810	20	-	-	25,673	30.8
1948	480	3,091	8,803	20,086	2,608	10	54	10	35,142	31.6
1949	11	336	2,016	32,099	16,936	42	-	-	51,430	33.1
1950	-	204	617	7,174	7,144	13	-	-	15,449	33.2
1951	47	778	2,130	14,261	6,954	81	-	-	24,251	32.7
1952	16	429	1,066	13,947	6,588	-	-	-	22,046	32.9
1953	-	601	1,108	11,149	9,436	175	-	-	22,469	33.1
1954	80	2,154	3,930	8,088	734	8	-	-	14,994	31.4
1955	10	428	791	11,788	9,090	71	-	-	22,178	33.1
1956	-	1,273	3,210	9,344	996	-	-	-	14,823	31.8
1957	-	40	185	4,923	2,864	-	-	-	8,012	33.2
1958	-	-	33	1,971	663	-	-	-	2,667	33.0
1959	-	-	55	1,921	1,347	-	-	-	3,323	33.3
1960	-	13	206	1,536	636	-	-	-	2,391	32.8

[1] Running bales - linters excluded.
[2] Includes all bales for which no specific length is assigned because of character defects.
Source: Cotton Quality Statistics, United States, USDA, PMA, Cotton Branch.

Table 18.—Staple Length of Upland Cotton Ginned in Louisiana, in District 3, 1939-60[1]

Year	Shorter than 7/8"[2]	7/8" and 29/32"	15/16" and 31/32"	1" and 1-1/32"	1-1/16" and 1-3/32"	1-1/8" and 1-5/32"	1-3/16" and 1-7/32"	1-1/4" and longer	All lengths	Average length
	Bales	Bales	Bales	Bales	Bales	Bales	Bales	Bales	Bales	32d. in.
1939	1,041	8,261	58,344	233,963	142,705	20,167	1,626	584	466,691	33.5
1940	50	135	6,256	103,083	42,628	2,028	98	12	154,290	33.0
1941	-	472	3,771	69,475	67,226	3,606	519	415	145,484	33.4
1942	115	1,714	30,305	140,090	59,053	10,285	2,454	1,331	245,347	33.0
1943	242	2,778	42,298	151,993	55,482	18,375	4,014	891	276,073	32.9
1944	53	206	21,285	133,267	65,038	20,462	2,643	232	243,186	33.2
1945	20	40	210	39,990	107,483	7,560	480	160	155,943	34.0
1946	-	50	1,870	51,485	42,090	2,650	620	170	98,935	33.5
1947	70	480	16,940	96,899	83,480	5,640	100	40	203,649	33.2
1948	-	21	2,708	90,527	217,844	4,435	83	19	315,637	33.9
1949	-	-	180	28,046	218,656	14,701	537	152	262,272	34.3
1950	-	-	44	31,909	145,926	6,199	429	52	184,559	34.1
1951	-	-	244	90,975	204,289	6,285	46	11	301,850	33.9
1952	-	113	1,626	84,734	224,613	1,104	-	-	312,190	33.8
1953	-	116	4,121	108,851	298,095	2,570	10	29	413,792	33.8
1954	10	8,604	43,242	120,310	74,727	554	10	-	247,457	32.6
1955	-	102	481	35,652	240,885	1,047	-	-	278,167	34.0
1956	-	33	1,724	102,423	180,966	844	-	-	285,990	33.7
1957	-	324	1,653	68,659	115,350	72	-	-	186,058	33.0
1958	-	86	1,035	51,916	99,037	500	-	-	152,574	33.7
1959	-	11	71	62,927	196,889	368	-	-	260,266	33.8
1960	-	88	1,162	131,392	136,630	266	-	-	269,538	33.5

[1] Running bales - linters excluded.

[2] Includes all bales for which no specific length is assigned because of character defects.

Source: Cotton Quality Statistics, United States, USDA, PMA, Cotton Branch.

Table 19.—Staple Length of Upland Cotton Ginned in Louisiana, in District 4, 1939-60[1]

Year	Shorter than 7/8"[2]	7/8" and 29/32"	15/16" and 31/32"	1" and 1-1/32"	1-1/16" and 1-3/32"	1-1/8" and 1-5/32"	1-3/16" and 1-7/32"	1-1/4" and longer	All lengths	Average length
	Bales	Bales	Bales	Bales	Bales	Bales	Bales	Bales	Bales	32d. in.
1939	-	939	5,793	13,468	3,428	88	-	-	23,706	32.7
1940	279	336	5,983	60,814	12,481	22	-	-	79,915	32.6
1941	73	147	3,988	43,597	42,509	84	-	-	90,398	33.2
1942	53	715	20,011	113,686	23,283	98	-	-	157,846	32.5
1943	13	2,771	25,251	136,245	49,069	926	70	-	214,345	32.7
1944	392	2,123	43,885	125,058	16,008	215	-	-	187,681	32.0
1945	20	150	2,260	73,340	35,811	320	-	10	111,911	33.1
1946	-	-	300	50,580	15,790	10	-	-	66,680	33.1
1947	10	10	1,090	71,541	63,100	320	-	-	136,071	33.4
1948	8	356	2,130	79,216	108,173	1,912	59	-	191,854	33.6
1949	-	-	404	47,944	88,053	447	-	-	136,848	33.7
1950	-	10	20	4,303	98,009	242	-	-	102,594	34.2
1951	-	53	684	64,311	173,265	1,782	59	-	240,154	33.8
1952	13	26	739	54,685	151,602	168	-	-	207,333	33.8
1953	-	-	191	38,877	118,194	1,481	16	-	148,759	33.8
1954	-	60	62	51,515	125,250	2,939	24	-	179,850	33.8
1955	-	119	539	52,035	90,811	84	-	-	143,588	33.6
1956	-	151	510	77,266	88,078	179	-	-	166,184	33.5
1957	-	-	127	19,308	54,079	-	-	-	73,514	33.7
1958	-	252	3,254	37,629	24,066	-	-	-	65,201	33.1
1959	-	-	73	37,443	53,323	-	-	-	90,839	33.6
1960	10	190	1,441	35,143	61,856	185	-	-	98,825	33.6

[1] Running bales - linters excluded.

[2] Includes all bales for which no specific length is assigned because of character defects.

Source: Cotton Quality Statistics, United States, USDA, PMA, Cotton Branch.

Table 20.—Preparation of Upland Cotton in Louisiana, by Period, 1933-60[1]

Ginning period	Normal		Rough		Gin Cut		Total	
	Bales	Per cent	Bales	Per cent	Bales	Per cent	Bales	Per cent
All Periods								
1933	419,948	89.3	50,131	10.7	121	*	469,300	100
1934	433,785	91.6	39,515	8.4	-	-	473,300	100
1935	471,701	87.1	69,699	12.9	-	-	541,400	100
1936	715,262	96.3	27,338	3.7	-	-	742,600	100
1937	991,382	94.4	58,188	5.5	1,030	0.1	1,050,600	100
1938	619,271	95.0	32,266	5.0	-	-	651,537	100
1939	667,974	93.0	49,947	7.0	-	-	717,921	100
1940	351,115	78.2	97,432	21.7	449	0.1	448,996	100
1941	216,091	69.6	94,074	30.3	310	0.1	310,475	100
1942	443,560	77.5	127,058	22.2	1,717	0.3	572,335	100
1943	648,397	91.0	63,415	8.9	712	0.1	712,524	100
1944	455,095	76.6	139,024	23.4	-	-	594,119	100
1945	344,738	91.3	32,970	8.7	-	-	377,708	100
1946	216,552	87.8	29,790	12.1	380	0.1	246,722	100
1947	446,872	91.2	41,690	8.5	1,280	0.3	489,842	100
1948	715,943	99.7	16,421	2.2	330	0.1	732,694	100
1949	598,151	94.4	34,070	5.4	1,395	0.2	633,616	100
1950	402,755	95.5	18,339	4.3	669	0.2	421,763	100
1951	736,493	98.3	12,297	1.6	436	0.1	749,226	100
1952	726,922	98.4	11,680	1.6	-	-	738,602	100
1953	784,325	98.6	10,938	1.4	10	*	795,273	100
1954	552,681	98.4	8,912	1.6	-	-	561,593	100
1955	561,922	98.3	9,961	1.7	17	*	571,900	100
1956	568,803	100.0	1,018	*	18	*	569,839	100
1957	344,550	99.7	1,163	0.3	-	-	345,713	100
1958	292,449	99.9	420	0.1	-	-	292,869	100
1959	486,658	99.9	285	0.1	-	-	486,943	100
1960	496,126	99.9	286	0.1	-	-	496,412	100

(Continued)

Table 20.— (Continued)

Ginning period	Normal		Rough		Gin Cut		Total	
	Bales	Per cent	Bales	Per cent	Bales	Per cent	Bales	Per cent
Prior to October[2]								
1933	264,103	86.4	41,320	13.5	377	0.1	305,800	100
1934	304,774	89.7	35,126	10.3	-	-	339,900	100
1935	299,063	81.8	66,437	18.2	-	-	365,500	100
1936	520,386	95.4	25,014	4.6	-	-	545,400	100
1937	613,482	91.8	53,768	8.1	650	0.1	667,900	100
1938	484,081	94.1	29,988	5.8	464	0.1	514,533	100
1939	522,879	91.8	46,982	8.2	-	-	569,861	100
1940	141,442	67.9	66,606	32.0	245	0.1	208,293	100
1941	134,123	64.4	73,630	35.4	389	0.2	208,142	100
1942	235,567	66.8	115,579	32.7	1,728	0.5	352,874	100
1943	439,331	89.0	53,724	10.9	428	0.1	493,483	100
1944	200,601	63.0	117,823	37.0	-	-	318,424	100
1945	163,505	85.0	28,930	15.0	-	-	192,435	100
1946	131,853	85.8	21,490	14.0	290	0.2	153,633	100
1947	277,586	90.7	27,200	8.9	1,160	0.4	305,946	100
1948	453,316	96.8	14,782	3.1	255	0.1	468,353	100
1949	318,475	67.9	28,674	6.1	255	-	348,454	100
1950	200,797	92.7	15,222	7.0	634	0.3	216,653	100
1951	423,198	97.2	11,821	2.7	436	0.1	435,455	100
1952	453,023	97.5	11,564	2.5	-	-	464,587	100
1953	287,283	97.6	6,948	2.4	10	*	294,241	100
1954	329,011	97.4	8,652	2.6	-	-	337,663	100
1955	246,508	96.3	9,538	3.7	17	*	256,063	100
1956	373,210	100.0	1,018	*	18	*	374,156	100
1957	96,375	99.3	694	0.7	-	-	97,069	100

(Continued)

Table 20.— (Continued)

Ginning period	Normal		Rough		Gin Cut		Total	
	Bales	Per cent	Bales	Per cent	Bales	Per cent	Bales	Per cent
During October[2/]								
1933	125,416	94.2	7,784	5.8	-	-	133,200	100
1934	111,977	96.2	4,423	3.8	-	-	116,400	100
1935	147,453	98.2	2,647	1.8	-	-	150,100	100
1936	166,028	98.7	2,272	1.3	-	-	168,300	100
1937	246,537	98.5	3,663	1.5	-	-	250,200	100
1938	127,278	98.6	1,849	1.4	-	-	129,127	100
1939	133,763	97.9	2,823	2.1	-	-	136,586	100
1940	170,490	86.3	27,065	13.7	-	-	197,555	100
1941	71,388	79.5	18,408	20.5	-	-	89,796	100
1942	182,671	94.9	9,817	5.1	-	-	192,488	100
1943	145,394	95.1	7,492	4.9	-	-	152,886	100
1944	182,849	93.6	12,502	6.4	-	-	195,351	100
1945	106,167	97.0	3,240	3.0	-	-	109,407	100
1946	68,593	91.5	6,370	8.5	10	*	74,973	100
1947	131,149	91.3	12,460	8.6	90	0.1	143,699	100
1948	192,703	99.4	1,198	0.6	21	*	193,922	100
1949	142,246	96.9	4,502	3.1	90	*	146,838	100
1950	146,367	98.1	2,787	1.9	35	*	149,189	100
1951	233,775	99.8	403	0.2	-	-	234,178	100
1952	212,472	99.6	65	0.4	-	-	212,537	100
1953	302,803	99.1	2,617	0.9	-	-	305,420	100
1954	163,844	99.8	260	0.2	-	-	164,104	100
1955	220,522	99.8	416	0.2	-	-	220,938	100
1956	151,409	100.0	-	-	-	-	151,409	100
1957	134,434	99.8	310	0.2	-	-	134,744	100

(Continued)

Table 20.— (Continued)

Ginning period	Normal		Rough		Gin Cut		Total	
	Bales	Per cent	Bales	Per cent	Bales	Per cent	Bales	Per cent
During November[2]								
1933	26,705	97.1	795	2.9	-	-	27,500	100
1934	13,500	100.0	-	-	-	-	13,500	100
1935	21,809	97.4	591	2.6	-	-	22,400	100
1936	25,298	99.6	102	0.4	-	-	25,400	100
1937	88,204	99.1	796	0.9	-	-	89,000	100
1938	6,742	99.4	39	0.6	-	-	6,781	100
1939	10,282	99.0	100	1.0	-	-	10,382	100
1940	31,220	90.1	3,430	9.9	-	-	34,650	100
1941	9,323	84.3	1,736	15.7	-	-	11,059	100
1942	23,657	94.2	1,457	5.8	-	-	25,114	100
1943	48,122	96.1	1,953	3.9	-	-	50,075	100
1944	51,296	89.7	5,890	10.3	-	-	57,186	100
1945	57,386	98.7	730	1.3	-	-	58,116	100
1946	12,341	87.0	1,770	12.5	80	0.5	14,191	100
1947	21,742	93.6	1,450	6.3	30	0.1	23,222	100
1948	39,829	98.9	392	1.0	47	0.1	40,268	100
1949	117,702	99.4	759	0.6	-	-	118,461	100
1950	49,524	99.4	285	0.6	-	-	49,809	100
1951	66,091	99.9	73	0.1	-	-	66,164	100
1952	47,112	99.9	42	0.1	-	-	47,154	100
1953	156,320	99.1	1,362	0.9	-	-	157,682	100
1954	55,387	100.0	-	-	-	-	55,387	100
1955	79,177	100.0	7	*	-	-	79,184	100
1956	35,421	100.0	-	-	-	-	35,421	100
1957	49,539	99.8	108	0.2	-	-	49,647	100

(Continued)

Table 20.— (Continued)

Ginning period	Normal		Rough		Gin Cut		Total	
	Bales	Per cent	Bales	Per cent	Bales	Per cent	Bales	Per cent
After November[2]								
1933	2,699	96.4	101	3.6	-	-	2,800	100
1934	3,500	100.0	-	-	-	-	3,500	100
1935	3,201	94.1	199	5.9	-	-	3,400	100
1936	3,400	97.1	100	2.9	-	-	3,500	100
1937	43,108	99.1	392	0.9	-	-	43,500	100
1938	1,092	99.6	4	0.4	-	-	1,096	100
1939	1,076	98.5	16	1.5	-	-	1,092	100
1940	8,082	95.1	416	4.9	-	-	8,498	100
1941	1,342	90.8	136	9.2	-	-	1,478	100
1942	1,708	91.9	151	8.1	-	-	1,859	100
1943	16,016	99.6	64	0.4	-	-	16,080	100
1944	20,587	88.9	2,571	11.1	-	-	23,158	100
1945	17,680	99.6	70	0.4	-	-	17,750	100
1946	3,765	95.9	160	4.1	-	-	3,925	100
1947	16,395	96.6	580	3.4	-	-	16,975	100
1948	30,095	99.8	49	0.2	7	*	30,151	100
1949	19,728	99.3	135	0.7	-	-	19,863	100
1950	6,067	99.3	45	0.7	-	-	6,112	100
1951	13,429	100.0	-	-	-	-	13,429	100
1952	14,315	99.9	9	0.1	-	-	14,324	100
1953	37,919	99.9	11	0.1	-	-	37,930	100
1954	4,439	100.0	-	-	-	-	4,439	100
1955	15,715	100.0	-	-	-	-	15,715	100
1956	8,853	100.0	-	-	-	-	8,853	100
1957	64,202	99.9	51	0.1	-	-	64,253	100

*Less than .05 per cent.

[1] Running bales; round bales counted as half bales; linters excluded.

[2] Not reported by periods after 1957.

Source: 1933-38 - Grade, Staple Length, and Tenderability of Cotton in United States, 1938-39, USDA, AMS, January, 1940.
1939-60 - Cotton Quality Statistics, United States, USDA, PMA, Cotton Branch.

Table 21.— Results of Classifications, Fiber Tests, Carded Yarn Processing Tests and Chemical Finishing Tests for Specified Varieties of Cotton Grown in Designated Market Areas, Louisiana, 1951-58.

Variety	Deltapine 15					
Market area	Bastrop				Bossier City	
Period of harvest	1951	1952	1953	1954	1951	1952
RAW COTTON QUALITY:						
Grade						
Early	M+	M+	M	SM	M	SM
Midseason	M	M	M	M	SLM	M+
Late	SLM+	M	SLM	SLM	SLM	M
Staple length						
Early	1-1/16	1-1/32	1-1/16	1-1/32	1-3/32	1-1/16
Midseason	1-1/16	1-1/32	1-1/16	1-1/32	1-1/16	1-1/16
Late	1-1/16	1	1-1/32	1	1-1/16	1-1/16
Fiber length (Fibrograph)						
Upper half mean (inches)						
Early	1.08	1.02	1.08	0.96	1.06	1.07
Midseason	1.09	1.07	1.02	1.01	1.08	1.12
Late	1.01	1.05	1.12	1.00	1.07	1.09
Uniformity ratio						
Early	80	79	81	78	79	79
Midseason	78	79	79	79	79	78
Late	78	80	79	80	79	80
Fiber fineness and maturity						
Micronaire reading						
Early	4.6	4.4	4.3	4.3	4.4	4.8
Midseason	4.8	4.6	4.5	4.2	4.6	4.8
Late	4.6	4.2	4.1	4.1	4.8	4.8
Fineness (Causticaire) ug/inch						
Early	-	-	-	-	-	-
Midseason	-	-	-	-	-	-
Late	-	-	-	-	-	-
Maturity (Causticaire) index						
Early	88	81	83	78	88	90
Midseason	88	88	82	82	88	90
Late	88	80	79	80	90	88
Fiber tensile strength (Pressley)						
Zero gauge - 1,000 p.s.i.						
Early	87	84	81	102	93	90
Midseason	89	80	81	92	86	88
Late	87	82	78	93	92	78
Nonlint content (Shirley Analyzer)						
Early	3.0	2.0	2.1	2.7	3.3	3.3
Midseason	3.3	2.5	3.3	2.5	3.5	2.7
Late	3.3	4.5	4.5	3.1	3.4	3.2

(Continued)

Table 21.— (Continued)

Variety	Deltapine 15					
Market area	Bastrop				Bossier City	
Period of harvest	1951	1952	1953	1954	1951	1952
Color of raw cotton						
Reflectance --Rd.						
Early	75.8	75.2	76.8	76.5	76.1	79.5
Midseason	72.0	75.0	76.9	75.4	75.5	77.2
Late	71.5	74.0	75.8	73.9	74.8	77.6
Yellowness -- +b						
Early	9.3	8.5	8.7	9.4	9.6	8.8
Midseason	9.7	8.2	8.3	8.8	9.2	8.9
Late	9.2	7.5	8.1	8.5	8.4	8.7
PROCESSING RESULTS:						
Manufacturing waste						
Picker and card per cent						
Early	7.2	5.9	5.9	6.6	7.0	6.8
Midseason	8.5	7.1	7.1	7.5	7.8	6.0
Late	8.9	9.7	9.9	8.0	7.5	7.0
Neps per 100 sq. inch of carded web						
Early	23	9	11	14	23	10
Midseason	14	11	8	7	13	7
Late	23	14	25	7	13	8
Yarn skein strength						
22s ---- pounds						
Early	117	106	119	117	124	126
Midseason	111	98	119	101	122	120
Late	108	104	113	99	117	114
50s ---- pounds						
Early	41	36	41	40	45	44
Midseason	38	33	41	33	44	43
Late	38	36	40	32	42	39
Yarn appearance						
22s ---- grade						
Early	B	B	B	B	B+	B+
Midseason	B	C+	B	C+	B+	B+
Late	B+	B	C+	B	B+	B
50s ---- grade						
Early	C+	C+	C+	C	B	B
Midseason	B	C	C+	C	B	C+
Late	C+	C+	D+	C	B+	C+
Average yarn appearance index						
Early	105	105	105	100	115	115
Midseason	110	95	105	95	115	110
Late	110	105	90	100	120	105

(Continued)

Table 21.— (Continued)

Variety	Deltapine 15					
Market area	Bossier City					Cheneyville
Period of harvest	1953	1954	1955	1956	1957	1951
RAW COTTON QUALITY:						
Grade						
Early	M	SM	M	SM	M	SM
Midseason	M+	MLtsp	M	M	M	M+
Late	SLM	MLtsp	SLM	SLM	SLMsp	SLM
Staple length						
Early	1-1/16	1-1/32	1-1/16	1-1/32	1-1/16	1-1/16
Midseason	1-1/16	1-1/32	1-1/16	1-1/32	1-1/16	1-1/16
Late	1-1/16	1	1-1/16	1	1-1/32	1-1/32
Fiber length (Fibrograph)						
Upper half mean (inches)						
Early	1.06	1.03	1.04	1.03	1.08	1.09
Midseason	1.10	1.05	1.02	1.01	1.08	1.03
Late	1.10	1.02	1.05	0.98	1.05	1.06
Uniformity ratio						
Early	80	80	80	81	81	79
Midseason	79	80	78	79	81	81
Late	79	79	78	80	77	80
Fiber fineness and maturity						
Micronaire reading						
Early	4.7	4.0	4.4	4.4	4.8	4.9
Midseason	4.1	4.1	4.8	4.4	4.6	4.6
Late	4.1	4.5	4.1	4.0	4.3	4.5
Fineness (Causticaire) ug/inch						
Early	-	-	-	4.3	4.7	-
Midseason	-	-	-	4.3	4.6	-
Late	-	-	-	4.1	4.4	-
Maturity (Causticaire) index						
Early	83	77	80	80	82	88
Midseason	81	81	81	79	80	88
Late	76	80	80	77	78	88
Fiber tensile strength (Pressley)						
Zero gauge - 1,000 p.s.i.						
Early	80	105	78	87	81	79
Midseason	78	97	72	84	83	82
Late	80	102	76	86	76	81
Nonlint content (Shirley Analyzer)						
Early	1.9	1.9	2.6	2.0	2.2	1.7
Midseason	2.9	2.9	2.6	2.4	2.4	1.9
Late	5.3	3.0	3.6	3.7	3.6	2.8

(Continued)

Table 21.— (Continued)

Variety	Deltapine 15					
Market area	Bossier City					Cheneyville
Period of harvest	1953	1954	1955	1956	1957	1951
Color of raw cotton						
Reflectance -- Rd.						
Early	78.8	76.9	77.2	76.1	73.4	77.3
Midseason	80.1	73.5	76.8	74.3	79.5	75.4
Late	75.8	72.0	75.5	72.3	66.0	72.4
Yellowness -- +b						
Early	8.6	9.7	9.2	9.4	9.3	8.7
Midseason	8.6	10.0	9.2	8.6	7.9	8.9
Late	9.0	9.8	8.1	8.5	9.5	8.2
PROCESSING RESULTS:						
Manufacturing waste						
Picker and card per cent						
Early	6.1	5.4	8.3	6.9	7.3	7.1
Midseason	6.4	7.4	8.9	7.6	7.2	5.8
Late	8.9	7.4	9.0	9.6	9.2	10.0
Neps per 100 sq. inch of card web						
Early	10	13	13	11	10	49
Midseason	14	8	12	13	10	38
Late	24	14	12	17	8	34
Yarn skein strength						
22s ---- pounds						
Early	118	119	119	125	123	112
Midseason	118	109	107	115	124	106
Late	120	104	110	108	114	98
50s ---- pounds						
Early	41	40	42	42	44	39
Midseason	41	36	37	39	44	37
Late	42	34	37	38	39	34
Yarn appearance						
22s ---- grade						
Early	B+	B	B	B	B	B+
Midseason	B	B+	B+	C+	B	B
Late	B	B	C+	C+	B	B
50s ---- grade						
Early	B	C	C+	C+	C+	C+
Midseason	C	B	C+	C	C+	C+
Late	C+	D+	C	C	C+	C
Average yarn appearance index						
Early	115	100	105	105	105	110
Midseason	100	115	110	95	105	105
Late	105	95	95	95	105	100

(Continued)

Table 21.— (Continued)

Variety	Deltapine 15						
Market area	Cheneyville						
Period of harvest	1952	1953	1954	1955	1956	1957	1958
RAW COTTON QUALITY:							
Grade							
Early	SM	M	SM	LM	SLM	SLM	SLMltsp
Midseason	SM	M	M	LM	SLM	SLM	LM
Late	SLM	SLM	SLM	LM	LM	LMltsp	SLM
Staple length							
Early	1-1/16	1-1/16	1-1/16	1-1/16	1-1/16	1-1/16	1-1/32
Midseason	1-1/32	1-1/16	1-1/16	1-1/16	1-1/16	1-1/16	1-1/16
Late	1-1/16	1-1/16	1-1/32	1-1/16	1-1/16	1-1/16	1-1/16
Fiber length (Fibrograph)							
Upper half mean (inches)							
Early	1.03	1.10	1.04	1.02	1.06	1.08	1.03
Midseason	1.05	1.10	1.07	1.03	1.05	1.07	1.06
Late	1.07	1.08	1.08	1.05	1.04	1.08	1.04
Uniformity ratio							
Early	81	80	81	78	82	81	76
Midseason	78	80	80	80	80	79	81
Late	79	80	79	79	80	80	71
Fiber fineness and maturity							
Micronaire reading							
Early	5.2	4.3	5.2	4.3	4.6	4.7	4.4
Midseason	5.0	4.2	4.8	4.3	4.5	4.5	4.5
Late	4.8	4.2	4.5	3.9	4.3	4.0	4.4
Fineness (Causticaire) ug/inch							
Early	-	-	-	-	4.5	4.7	4.7
Midseason	-	-	-	-	4.5	4.6	4.5
Late	-	-	-	-	4.2	4.1	4.3
Maturity (Causticaire) index							
Early	89	85	84	80	81	80	78
Midseason	88	82	83	79	80	79	80
Late	90	76	82	79	79	76	80
Fiber tensile strength (Pressley)							
Zero gauge - 1,000 p.s.i.							
Early	77	75	102	70	80	76	76
Midseason	78	76	97	72	82	79	74
Late	78	74	93	74	79	77	74
Nonlint content (Shirley Analyzer)							
Early	1.2	2.1	1.9	3.6	2.7	3.4	4.8
Midseason	2.1	2.5	1.8	5.6	3.7	3.7	3.2
Late	3.0	3.0	3.3	4.3	3.9	3.9	2.3

(Continued)

Table 21.— (Continued)

Variety	Deltapine 15						
Market area	Cheneyville						
Period of harvest	1952	1953	1954	1955	1956	1957	1958
Color of raw cotton							
Reflectance -- Rd.							
Early	79.3	71.7	76.5	71.2	71.3	71.5	63.5
Midseason	75.6	77.6	76.3	74.5	72.5	73.5	68.5
Late	76.2	74.9	74.4	75.3	66.5	67.5	73.1
Yellowness -- +b							
Early	8.7	9.4	9.1	8.7	8.9	9.2	8.9
Midseason	9.3	8.3	8.6	9.5	8.0	8.7	8.0
Late	8.7	7.3	8.4	8.2	8.1	8.0	7.9
PROCESSING RESULTS:							
Manufacturing waste							
Picker and card per cent							
Early	5.9	6.9	6.1	11.5	7.5	9.0	10.4
Midseason	5.6	6.0	6.3	11.1	9.0	8.8	8.2
Late	6.0	6.6	7.9	10.2	10.2	10.0	6.7
Neps per 100 sq. inch of card web							
Early	19	9	5	18	12	13	14
Midseason	14	15	9	12	15	9	19
Late	14	28	5	28	22	13	14
Yarn skein strength							
22s ---- pounds							
Early	102	102	115	92	118	109	91
Midseason	103	114	111	99	115	104	102
Late	103	114	106	102	110	115	106
50s ---- pounds							
Early	36	35	40	31	41	37	31
Midseason	37	39	38	32	40	36	35
Late	35	40	36	34	38	40	36
Yarn appearance							
22s ---- grade							
Early	B	B	B	B	B	B	C+
Midseason	B	B	B	B	B	B	C
Late	B	C+	B	C+	C+	C+	C+
50s ---- grade							
Early	C+	C+	C+	C	C+	C	D+
Midseason	C+	C+	C+	C+	C+	C	D+
Late	C	C	C	C	C	C	D+
Average yarn appearance index							
Early	105	105	105	100	105	100	90
Midseason	105	105	105	105	105	100	83
Late	100	95	100	95	95	95	90

(Continued)

Table 21.— (Continued)

Variety	[illegible]ine 15					
Market area	Ville [illegible]					
Period of harvest	1951	1952	1953	1954	1955	1956
RAW COTTON QUALITY:						
Grade						
Early	M+	M+	M	SM	SLM	M
Midseason	SLMltsp	M+	M	M+	M	SLM
Late	SLM	SLM+	SLM+	SLM+	SLM	SLM
Staple length						
Early	1-1/16	1-1/16	1-1/16	1-1/16	1-1/16	1-1/32
Midseason	1-1/16	1-1/16	1-1/16	1-1/16	1-1/16	1-1/16
Late	1-1/16	1-1/16	1-1/16	1-1/16	1-1/16	1-1/32
Fiber length (Fibrograph)						
Upper half mean (inches)						
Early	1.03	1.06	1.07	1.06	1.04	1.02
Midseason	1.01	1.06	1.09	1.04	1.06	1.00
Late	1.01	1.10	1.05	1.07	1.03	0.96
Uniformity ratio						
Early	80	78	80	81	79	79
Midseason	79	80	81	80	81	82
Late	80	80	80	80	80	80
Fiber fineness and maturity						
Micronaire reading						
Early	4.6	5.2	4.0	5.0	4.6	4.7
Midseason	4.4	4.8	4.1	4.5	4.5	4.6
Late	4.3	4.7	3.6	4.6	4.3	4.6
Fineness (Causticaire) ug/inch						
Early	-	-	-	-	-	4.8
Midseason	-	-	-	-	-	4.6
Late	-	-	-	-	-	4.6
Maturity (Causticaire) index						
Early	86	85	85	82	81	80
Midseason	86	84	81	81	79	79
Late	87	84	74	80	80	80
Fiber tensile strength (Pressley)						
Zero gauge - 1,000 p.s.i.						
Early	82	82	80	106	69	84
Midseason	85	80	87	101	75	84
Late	83	80	81	94	76	82
Nonlint content (Shirley Analyzer)						
Early	2.6	2.4	3.3	3.5	4.6	3.3
Midseason	3.0	2.8	3.2	3.0	3.6	4.3
Late	3.8	3.3	4.8	4.9	4.2	4.2

(Continued)

Table 21.— (Continued)

Variety	Deltapine 15					
Market area	Ville Platte					
Period of harvest	1951	1952	1953	1954	1955	1956
Color of raw cotton						
Reflectance -- Rd.						
Early	78.0	79.0	77.2	80.0	75.5	75.5
Midseason	73.0	77.8	78.0	78.9	77.5	70.0
Late	73.5	76.0	80.0	76.8	76.0	71.5
Yellowness -- +b						
Early	9.1	9.1	9.0	9.1	9.2	9.6
Midseason	9.5	9.1	8.9	9.0	9.4	8.3
Late	8.6	9.3	8.3	9.0	8.8	8.5
PROCESSING RESULTS:						
Manufacturing waste						
Picker and card per cent						
Early	7.2	5.4	6.2	6.8	9.6	8.6
Midseason	7.4	5.6	5.7	7.0	9.0	9.1
Late	9.1	7.2	7.6	8.3	9.0	10.3
Neps per 100 sq. inch of card web						
Early	13	14	5	7	6	14
Midseason	16	8	8	8	6	4
Late	24	8	24	6	8	9
Yarn skein strength						
22s ---- pounds						
Early	119	115	120	126	108	118
Midseason	117	113	124	122	114	113
Late	107	106	122	115	109	109
50s ---- pounds						
Early	41	41	41	43	36	39
Midseason	40	39	43	42	38	40
Late	36	38	43	40	37	36
Yarn appearance						
22s ---- grade						
Early	B+	B+	B+	B+	B+	B+
Midseason	B+	B+	B+	B	B	B
Late	B	B+	B	B	B+	B
50s ---- grade						
Early	B	B	B	B	C+	C+
Midseason	B	C+	B	B	C+	C+
Late	B	C+	C	C+	B	C+
Average yarn appearance index						
Early	115	115	115	115	110	110
Midseason	115	110	115	110	105	105
Late	110	110	100	105	115	105

(Continued)

Table 21.— (Continued)

Variety	Deltapine 15					
Market area	Lake Providence					
Period of harvest	1952	1953	1954	1955	1956	1957
RAW COTTON QUALITY:						
Grade						
Early	SM	M	M+	SM	M	M
Midseason	M	SLM+	M	M	SM	SLM
Late	M	SLM	SLM+	SLM	SLM	SLMltsp
Staple length						
Early	1-1/16	1-3/32	1-1/16	1-3/32	1-3/32	1-1/16
Midseason	1-1/16	1-3/32	1-1/32	1-3/32	1-3/32	1-1/16
Late	1-1/32	1-1/16	1-1/32	1-1/16	1-1/16	1-1/16
Fiber length (Fibrograph)						
Upper half mean (inches)						
Early	1.06	1.06	1.07	1.08	1.08	1.07
Midseason	1.04	1.11	1.11	1.04	1.06	1.08
Late	1.05	1.13	1.13	1.06	1.08	1.08
Uniformity ratio						
Early	78	79	80	81	80	80
Midseason	78	79	79	78	79	81
Late	79	80	81	79	81	78
Fiber fineness and maturity						
Micronaire reading						
Early	4.3	4.1	4.2	4.1	4.0	4.8
Midseason	4.2	4.0	4.1	4.4	4.5	4.8
Late	4.2	3.8	4.4	3.8	4.3	4.2
Fineness (Causticaire) ug/inch						
Early	-	-	-	-	4.1	4.7
Midseason	-	-	-	-	4.6	4.7
Late	-	-	-	-	4.7	4.4
Maturity (Causticaire) index						
Early	83	80	79	78	76	82
Midseason	87	79	85	76	79	82
Late	81	80	77	76	83	78
Fiber tensile strength (Pressley)						
Zero gauge - 1,000 p.s.i.						
Early	82	75	106	76	81	77
Midseason	83	75	101	78	85	74
Late	82	75	104	78	80	78
Nonlint content (Shirley Analyzer)						
Early	2.5	2.3	3.3	1.8	1.8	2.6
Midseason	3.3	3.5	4.0	3.5	1.7	3.8
Late	3.4	3.8	4.1	3.1	3.4	2.8

(Continued)

Table 21.— (Continued)

Variety	Deltapine 15					
Market area	Lake Providence					
Period of harvest	1952	1953	1954	1955	1956	1957
Color of raw cotton						
Reflectance -- Rd.						
Early	78.5	79.1	77.6	78.5	72.5	73.4
Midseason	80.0	77.5	76.9	76.5	76.5	71.4
Late	80.0	75.9	77.5	75.0	72.3	63.5
Yellowness -- +b						
Early	8.6	8.7	8.9	8.8	9.4	8.7
Midseason	8.3	8.5	8.9	9.0	8.5	8.5
Late	8.0	7.8	8.3	8.7	7.9	9.0
PROCESSING RESULTS:						
Manufacturing waste						
Picker and card per cent						
Early	6.6	6.0	7.5	7.4	7.0	8.0
Midseason	7.3	5.8	7.9	7.5	7.5	8.2
Late	8.4	7.6	8.2	8.8	8.2	9.6
Neps per 100 sq. inch of card web						
Early	10	15	10	15	14	12
Midseason	16	13	7	11	16	16
Late	13	22	6	13	15	18
Yarn skein strength						
22s ---- pounds						
Early	110	112	124	119	125	107
Midseason	97	115	116	113	120	111
Late	97	115	121	109	115	108
50s ---- pounds						
Early	38	40	43	40	44	38
Midseason	32	41	41	38	40	38
Late	33	40	42	36	40	38
Yarn appearance						
22s ---- grade						
Early	B+	B	B	B	C+	B
Midseason	B	B	B	B	B	B
Late	B	B	B	C+	B	C+
50s ---- grade						
Early	B	C+	C+	C	C	C+
Midseason	C+	C	C+	C+	C	C+
Late	C	C	C+	D+	C+	D+
Average yarn appearance index						
Early	115	105	105	100	95	105
Midseason	105	100	105	105	100	105
Late	100	100	105	90	105	90

(Continued)

Table 21.— (Continued)

Variety	Deltapine 15					
Market area	Newellton				Natchitoches	
Period of harvest	1952	1953	1954	1957	1954	1955
RAW COTTON QUALITY:						
Grade						
Early	SM	SM	SM	M	M	M
Midseason	M	SLM	SLM	SLM	M	SLM
Late	SLM	SLM	SLM	SLMltsp	SLM	LM
Staple length						
Early	1-1/16	1-3/32	1-1/16	1-3/32	1-1/32	1-1/32
Midseason	1-1/16	1-3/32	1-1/16	1-3/32	1-1/32	1-1/32
Late	1-1/32	1-1/16	1-1/16	1-1/16	1	1-1/32
Fiber length (Fibrograph)						
Upper half mean (inches)						
Early	1.05	1.15	1.03	1.09	1.02	1.00
Midseason	1.06	1.11	1.06	1.09	1.00	1.06
Late	0.99	1.06	1.04	1.06	1.04	1.00
Uniformity ratio						
Early	79	80	80	79	81	79
Midseason	79	79	80	80	80	80
Late	79	79	79	79	80	79
Fiber fineness and maturity						
Micronaire reading						
Early	4.7	4.6	4.2	4.6	4.9	4.5
Midseason	4.7	4.2	4.2	4.6	4.5	4.6
Late	4.5	3.8	4.1	4.4	4.8	4.3
Fineness (Causticaire) ug/inch						
Early	-	-	-	4.8	-	-
Midseason	-	-	-	4.4	-	-
Late	-	-	-	4.6	-	-
Maturity (Causticaire) index						
Early	86	81	82	78	79	80
Midseason	87	81	79	80	83	80
Late	82	79	81	77	83	80
Fiber tensile strength (Pressley)						
Zero gauge - 1,000 p.s.i.						
Early	82	80	104	75	107	74
Midseason	82	73	100	76	99	74
Late	84	77	100	77	90	71
Nonlint content (Shirley Analyzer)						
Early	1.8	1.3	2.0	3.0	2.8	2.9
Midseason	3.2	3.3	3.5	2.8	2.6	2.6
Late	3.0	3.5	4.8	3.6	2.8	3.7

(Continued)

Table 21.—(Continued)

Variety	Deltapine 15					
Market area	Newellton				Natchitoches	
Period of harvest	1952	1953	1954	1957	1954	1955
Color of raw						
Reflectance -- Rd.						
Early	79.5	78.4	78.0	74.5	75.5	76.0
Midseason	78.5	73.5	76.0	74.5	77.5	73.0
Late	75.0	76.2	75.4	65.1	74.3	70.4
Yellowness -- +b						
Early	8.6	8.6	9.0	9.0	9.5	8.9
Midseason	7.9	8.5	8.3	7.9	8.9	8.9
Late	8.1	7.7	8.4	8.3	9.0	9.1
PROCESSING RESULTS:						
Manufacturing waste						
Picker and card per cent						
Early	5.4	4.7	6.0	8.0	7.4	9.1
Midseason	6.9	7.0	7.4	8.1	6.7	9.6
Late	7.9	8.5	8.6	9.3	7.3	11.1
Neps per 100 sq. inch of card web						
Early	11	7	18	12	12	15
Midseason	11	19	11	15	16	14
Late	14	34	7	15	6	21
Yarn skein strength						
22s ---- pounds						
Early	117	116	113	109	115	101
Midseason	104	112	109	109	107	94
Late	98	114	108	108	101	87
50s ---- pounds						
Early	40	40	39	39	38	34
Midseason	35	40	38	39	36	31
Late	33	40	37	36	34	28
Yarn appearance						
22s ---- grade						
Early	B+	B+	B	B	B	B
Midseason	B	B+	B	C+	B	B
Late	B	B	B	C+	B	C+
50s ---- grade						
Early	B	B	D+	C+	C	C
Midseason	C	C	C	C	C	C
Late	C+	C	C	C	C+	D+
Average yarn appearance index						
Early	115	115	95	105	100	100
Midseason	100	105	100	95	100	100
Late	105	100	100	95	105	90

(Continued)

Table 21.— (Continued)

Variety	Deltapine 15					
Market area	Natchitoches			Shreveport		
Period of harvest	1956	1957	1958	1956	1957	1958
RAW COTTON QUALITY:						
Grade						
Early	M	Mltsp	SLM	M	M	SLM
Midseason	SLM	SLM	LM	M	SLM	SLM
Late	LM	SLMltsp	SLM	SLM	SLMltsp	M
Staple length						
Early	1-1/32	1-1/16	1-1/32	1-1/32	1-1/16	1-1/16
Midseason	1-1/32	1-1/32	1-1/32	1-1/32	1-1/16	1-1/16
Late	1-1/32	1-1/32	1-1/32	1	1-1/16	1-1/16
Fiber length (Fibrograph)						
Upper half mean (inches)						
Early	1.02	1.04	1.05	0.98	1.07	1.08
Midseason	1.01	1.04	1.04	1.06	1.08	1.09
Late	1.04	1.04	1.04	0.98	1.07	1.09
Uniformity ratio						
Early	78	81	76	80	79	81
Midseason	80	80	75	80	80	81
Late	80	77	72	79	80	76
Fiber fineness and maturity						
Micronaire reading						
Early	4.1	4.8	4.4	4.1	4.6	5.2
Midseason	4.5	4.6	3.9	4.6	4.7	4.8
Late	4.3	4.5	3.8	4.4	4.6	4.1
Fineness (Causticaire) ug/inch						
Early	4.0	4.8	4.6	4.2	4.7	5.2
Midseason	4.2	4.7	4.2	4.7	4.7	4.9
Late	4.3	4.3	3.7	4.4	4.6	4.0
Maturity (Causticaire) index						
Early	78	81	78	77	80	83
Midseason	82	80	74	80	80	80
Late	79	81	76	79	81	79
Fiber tensile strength (Pressley)						
Zero gauge - 1,000 p.s.i.						
Early	82	77	77	89	84	81
Midseason	84	83	75	86	86	80
Late	84	80	78	87	80	79
Nonlint content (Shirley Analyzer)						
Early	2.7	2.7	3.1	1.8	2.2	3.2
Midseason	3.7	4.0	3.9	3.0	3.9	2.8
Late	5.0	3.5	3.7	2.4	3.1	2.6

(Continued)

Table 21.— (Continued)

Variety	Deltapine 15					
Market area	Natchitoches			Shreveport		
Period of harvest	1956	1957	1958	1956	1957	1958
Color of raw cotton						
Reflectance -- Rd.						
Early	74.5	69.6	68.6	72.4	75.3	70.0
Midseason	71.3	75.4	74.3	73.3	71.3	74.5
Late	68.4	64.0	73.0	71.5	66.5	76.5
Yellowness -- +b						
Early	9.1	9.0	9.1	9.7	8.9	8.7
Midseason	8.5	8.3	7.8	8.8	8.7	7.8
Late	8.5	8.2	7.5	7.6	8.2	7.6
PROCESSING RESULTS:						
Manufacturing waste						
Picker and card per cent						
Early	7.8	9.0	9.2	7.7	7.0	8.1
Midseason	9.9	10.0	9.8	8.6	9.2	7.8
Late	11.1	10.1	8.9	8.5	8.6	6.5
Neps per 100 sq. inch of card web						
Early	21	13	16	16	10	11
Midseason	20	12	20	14	10	10
Late	12	8	22	12	4	18
Yarn skein strength						
22s ---- pounds						
Early	118	112	99	124	126	107
Midseason	107	111	99	116	123	111
Late	109	106	104	110	115	119
50s ---- pounds						
Early	40	39	34	43	45	37
Midseason	37	39	33	38	43	39
Late	38	37	36	38	40	42
Yarn appearance						
22s ---- grade						
Early	C+	C+	C+	B	B	B
Midseason	C+	C+	D+	B	B	C+
Late	B	C+	C	B	C+	C+
50s ---- grade						
Early	D+	C	C	C+	C+	C+
Midseason	D+	C	D	C+	C+	C
Late	C	D+	D	C+	C+	D+
Average yarn appearance index						
Early	90	95	95	105	105	105
Midseason	90	95	75	105	105	95
Late	100	90	80	105	100	90

(Continued)

Table 21.— (Continued)

Variety	Deltapine 15					
Market area	Winnsboro			Tallulah		
Period of harvest	1955	1956	1957	1955	1956	1957
RAW COTTON QUALITY:						
Grade						
Early	M	M	SLM	LM	SLM	M
Midseason	M	SLM+	SLM	LM	SLM	M
Late	SLM	SLM	SLM	LM	LM	SLMltsp
Staple length						
Early	1-1/16	1-1/16	1-1/16	1-3/32	1-3/32	1-1/16
Midseason	1-1/16	1-1/16	1-1/16	1-3/32	1-3/32	1-1/16
Late	1-1/16	1-1/16	1-1/16	1-1/16	1-1/16	1-1/16
Fiber length (Fibrograph)						
Upper half mean (inches)						
Early	1.06	0.96	1.07	1.07	1.08	1.08
Midseason	1.03	1.05	1.04	1.05	1.07	1.06
Late	1.04	1.04	1.04	1.05	1.06	1.07
Uniformity ratio						
Early	79	80	80	80	81	80
Midseason	80	79	77	78	80	78
Late	80	80	79	80	81	80
Fiber fineness and maturity						
Micronaire reading						
Early	4.6	4.6	4.6	3.7	4.6	4.6
Midseason	4.7	4.5	4.4	3.6	4.6	4.6
Late	4.4	4.6	4.6	3.7	4.6	4.4
Fineness (Causticaire) ug/inch						
Early	-	4.6	4.6	-	4.6	4.6
Midseason	-	4.5	4.6	-	4.4	4.7
Late	-	4.6	4.7	-	4.4	4.4
Maturity (Causticaire) index						
Early	81	80	79	72	80	80
Midseason	79	80	79	71	80	80
Late	80	80	79	74	82	79
Fiber tensile strength (Pressley)						
Zero gauge - 1,000 p.s.i.						
Early	75	84	78	79	85	77
Midseason	76	80	77	77	83	77
Late	75	82	77	73	78	76
Nonlint content (Shirley Analyzer)						
Early	3.8	2.7	3.4	7.9	3.2	2.8
Midseason	4.9	3.9	2.6	7.5	3.8	3.9
Late	7.3	5.3	3.0	6.3	7.8	4.1

(Continued)

Table 21.— (Continued)

Variety	Deltapine 15					
Market area	Winnsboro			Tallulah		
Period of harvest	1955	1956	1957	1955	1956	1957
Color of raw cotton						
Reflectance -- Rd.						
Early	75.0	72.9	66.5	74.5	73.5	73.0
Midseason	73.5	75.0	64.6	72.5	75.4	72.5
Late	73.5	73.0	70.4	77.0	70.4	65.5
Yellowness -- +b						
Early	9.2	9.0	8.9	8.7	8.1	8.7
Midseason	9.3	8.5	9.4	8.5	9.0	8.6
Late	9.0	7.9	8.4	7.8	6.7	8.7
PROCESSING RESULTS:						
Manufacturing waste						
Picker and card per cent						
Early	8.9	8.5	10.0	16.9	8.1	8.0
Midseason	9.5	9.3	8.8	13.5	9.0	8.7
Late	12.0	9.4	9.8	10.3	11.4	8.8
Neps per 100 sq. inch of card web						
Early	12	6	12	26	6	13
Midseason	8	11	14	33	12	8
Late	9	11	15	21	11	9
Yarn skein strength						
22s ---- pounds						
Early	109	115	108	121	127	110
Midseason	108	115	105	112	118	113
Late	100	110	100	104	115	107
50s ---- pounds						
Early	37	39	38	42	44	38
Midseason	37	39	37	38	41	39
Late	34	37	35	35	40	38
Yarn appearance						
22s ---- grade						
Early	B+	B	B	C+	B+	B+
Midseason	B+	B	B	C+	B	B
Late	B	B	C	B	B	C+
50s ---- grade						
Early	C+	C+	C	D+	C+	C+
Midseason	C+	C+	C	D+	C	C+
Late	C	C+	D+	C	C	C
Average yarn appearance index						
Early	110	105	100	90	110	110
Midseason	110	105	100	90	100	105
Late	100	105	85	100	100	95

(Continued)

Table 21.— (Continued)

Variety	Deltapine 15					
Market area	Mer Rouge			Monroe	Waterproof	Gilbert
Period of harvest	1955	1956	1957	1957	1958	1958
RAW COTTON QUALITY:						
Grade						
Early	M	M	SLM	M	SLM	LM
Midseason	M	M	M	M	M	SLMlts
Late	SLM	SLM	SLMltsp	SLMltsp	SLM	SLMlts
Staple length						
Early	1-1/16	1-1/16	1-3/32	1-1/16	1-1/16	1-1/32
Midseason	1-1/16	1-1/16	1-1/16	1-1/16	1-1/16	1-1/16
Late	1-1/16	1-1/32	1-1/32	1-1/32	1-1/16	1-1/16
Fiber length (Fibrograph)						
Upper half mean (inches)						
Early	1.03	0.97	1.10	1.07	1.09	1.02
Midseason	1.04	1.06	1.07	1.06	1.08	1.04
Late	1.02	1.00	1.04	1.05	1.08	1.08
Uniformity ratio						
Early	80	79	82	80	78	75
Midseason	79	80	79	79	79	78
Late	80	80	80	76	78	78
Fiber fineness and maturity						
Micronaire reading						
Early	4.4	4.6	4.6	4.8	4.6	4.8
Midseason	4.3	4.6	4.5	4.6	4.8	4.9
Late	4.2	4.5	4.6	3.4	4.6	4.6
Fineness (Causticaire) ug/inch						
Early	-	4.7	4.6	4.8	4.6	5.1
Midseason	-	4.8	4.6	4.8	4.9	5.1
Late	-	4.7	4.8	3.7	4.5	4.9
Maturity (Causticaire) index						
Early	80	80	81	81	81	79
Midseason	77	79	80	78	79	80
Late	77	81	79	71	81	78
Fiber tensile strength (Pressley)						
Zero gauge - 1,000 p.s.i.						
Early	75	85	81	74	78	81
Midseason	75	89	78	72	79	79
Late	75	83	77	75	87	84
Nonlint content (Shirley Analyzer)						
Early	3.1	3.1	2.0	2.0	3.5	4.2
Midseason	3.0	3.0	2.7	3.3	2.0	3.5
Late	4.7	2.9	4.2	3.1	1.8	3.6

(Continued)

Table 21.— (Continued)

Variety	Deltapine 15					
Market area	Mer Rouge			Monroe	Waterproof	Gilbert
Period of harvest	1955	1956	1957	1957	1958	1958
Color of raw cotton						
Reflectance -- Rd.						
Early	76.5	71.4	72.5	75.5	69.3	64.4
Midseason	75.5	73.4	71.8	73.5	77.5	66.5
Late	76.6	70.0	68.0	68.5	72.5	68.5
Yellowness -- +b						
Early	9.0	9.3	8.4	8.6	7.8	8.8
Midseason	8.9	8.5	8.6	8.2	8.1	8.7
Late	8.1	7.5	9.0	8.9	7.1	8.4
PROCESSING RESULTS:						
Manufacturing waste						
Picker and card per cent						
Early	8.4	7.9	7.9	8.1	8.3	9.4
Midseason	6.7	8.2	7.6	8.0	6.4	9.4
Late	9.5	8.5	9.7	9.8	6.7	9.2
Neps per 100 sq. inch of card web						
Early	8	8	8	12	8	13
Midseason	15	12	9	11	7	11
Late	7	12	3	28	14	10
Yarn skein strength						
22s ---- pounds						
Early	113	122	119	110	106	95
Midseason	112	116	111	106	107	93
Late	106	111	105	105	126	103
50s ---- pounds						
Early	38	41	43	39	37	32
Midseason	39	39	39	37	36	31
Late	35	37	37	36	44	35
Yarn appearance						
22s ---- grade						
Early	B	B+	B+	B+	C+	C+
Midseason	B	B	B	B+	C+	C
Late	B+	B	B	C	C+	C
50s ---- grade						
Early	C+	C+	C+	C	D+	D+
Midseason	C+	C+	C+	C	C	D
Late	C+	C+	C+	D+	C	D+
Average yarn appearance index						
Early	105	110	110	105	85	90
Midseason	105	105	105	105	95	80
Late	110	105	105	85	95	85

(Continued)

Table 21.—(Continued)

Variety	Deltapine 15	
Market area	Bunkie	Bonita
Period of harvest	1958	1958
RAW COTTON QUALITY:		
Grade		
Early	LM	SLM
Midseason	SLMltsp	SLM
Late	SLM	M
Staple length		
Early	1-1/32	1-1/16
Midseason	1-1/16	1-3/32
Late	1-1/16	1-1/16
Fiber length (Fibrograph)		
Upper half mean (inches)		
Early	1.05	1.10
Midseason	1.05	1.10
Late	1.07	1.08
Uniformity ratio		
Early	76	78
Midseason	80	81
Late	76	77
Fiber fineness and maturity		
Micronaire reading		
Early	4.6	4.7
Midseason	4.8	4.4
Late	4.6	4.2
Fineness (Causticaire) ug/inch		
Early	4.5	4.7
Midseason	5.0	4.5
Late	4.5	4.4
Maturity (Causticaire) index		
Early	81	80
Midseason	80	79
Late	81	77
Fiber tensile strength (Pressley)		
Zero gauge - 1,000 p.s.i.		
Early	75	75
Midseason	75	78
Late	74	76
Nonlint content (Shirley Analyzer)		
Early	4.1	2.6
Midseason	2.7	3.0
Late	3.0	1.9

(Continued)

Table 21.— (Continued)

Variety	Deltapine 15	
Market area	Bunkie	Bonita
Period of harvest	1958	1958
Color of raw cotton		
Reflectance -- Rd.		
Early	65.9	70.0
Midseason	70.5	75.0
Late	77.7	74.6
Yellowness -- +b		
Early	8.3	8.4
Midseason	7.4	8.1
Late	7.6	8.3
PROCESSING RESULTS:		
Manufacturing waste		
Picker and card per cent		
Early	9.0	7.7
Midseason	7.9	7.4
Late	7.9	6.3
Neps per 100 sq. inch of card web		
Early	16	9
Midseason	10	8
Late	11	9
Yarn skein strength		
22s ---- pounds		
Early	93	101
Midseason	98	114
Late	104	115
50s ---- pounds		
Early	32	35
Midseason	33	40
Late	36	39
Yarn appearance		
22s ---- grade		
Early	C+	C+
Midseason	C+	C+
Late	C+	C+
50s ---- grade		
Early	D+	C
Midseason	D+	D+
Late	C	C
Average yarn appearance index		
Early	90	95
Midseason	90	90
Late	95	95

Table 22.—Fiber Tests and Carded Yarn Processing Test Results by Market Areas Louisiana, 1959

Variety	Deltapine					
Market area	Bunkie					
Period of harvest	1st	2nd	3rd	4th	5th	6th
RAW COTTON QUALITY:						
Classification (off. std.):						
Grade - designation	SLM	M	SLM	SLM	SLM	SLM
Staple length - inches	1-1/16	1-1/16	1-1/16	1-1/16	1-1/16	1-1/32
Fiber Length (Fibrograph):						
Upper half mean - inches	1.09	1.07	1.08	1.09	1.07	1.05
Uniformity - ratio	78	79	78	77	78	74
Fiber Fineness & Maturity:						
Micronaire - readings	4.8	4.8	4.4	4.4	4.2	3.8
Fineness (Causticaire) ug/in.	4.5	4.7	4.4	4.3	4.2	4.2
Maturity (") index	82	81	80	79	78	74
Fiber Strength (Pressley)						
Zero gauge - 1,000 p.s.i.	76	75	76	75	74	75
Zero gauge - gm. per tex	37.6	37.1	37.6	37.1	36.6	37.1
1/8 in. gauge - gm. per tex	19.9	19.5	20.0	20.5	20.3	20.7
Shirley Analyzer:						
Visible waste - %	0.7	0.8	1.1	1.6	1.5	1.5
Invisible " - %	1.0	1.3	1.6	1.2	1.3	1.7
Total nonlint cont. - %	1.7	2.1	2.7	2.8	2.3	3.2
Color of Raw Cotton:						
Reflectance - Rd.	73.9	73.3	72.0	71.3	71.0	73.9
Yellowness - +b	8.3	8.2	8.1	7.9	8.5	7.5
Color index	97	102	94	92	92	96
Sugar content - %	0.1	0.0	0.0	0.0	0.0	0.0
Acid Alkaline Value - ph	8.2	8.9	8.2	8.9	8.9	8.1
PROCESSING RESULTS:						
Manufacturing Waste						
Picker and card - %	7.1	8.2	8.4	7.8	8.6	8.7
Neps - per 100 sq. in. card web	13	13	10	15	18	30
Yarn Skein Strength - Grey Yarn						
22s (26.8 tex) - pounds	101	102	109	105	103	106
50s (11.8 tex) - pounds	34	36	37	38	36	36
Average break factor	1961	2022	2124	2105	2033	2066
Yarn Appearance (Grey)						
22s (26.8 tex) - grade	B	B	C+	B	C+	C
50s (11.8 tex) - grade	C+	C+	C	C	D+	C
Average yarn appear. index	105	105	95	100	90	80
Color of 22s Carded Yarn						
Grey						
Reflectance - Rd.	69.0	69.4	67.9	67.2	66.3	66.6
Yellowness - +b	10.8	11.3	10.9	10.9	10.4	10.2
Color index	93	96	91	90	87	87
Bleached						
Reflectance - Rd.	84.7	85.3	85.2	82.9	83.6	82.0
Yellowness - +b	2.8	2.9	3.1	3.1	3.2	2.8
Color index	105	106	105	100	101	99
Dyed after bleaching						
Reflectance - Rd.	24.7	26.4	26.2	27.3	28.2	27.1
Blueness - -b	27.9	27.0	26.6	25.7	25.8	26.1
Color index	116	109	108	102	101	104

(Continued)

Table 22.— (Continued)

Variety :	Deltapine					
Market area :	Shreveport					
Period of harvest :	1st	2nd	3rd	4th	5th	6th
RAW COTTON QUALITY:						
Classification (off. std.):						
Grade - designation	SLM	SLM	SLM	SLM	M	LM
Staple length - inches	1-1/16	1-1/32	1-1/16	1-1/16	1-1/16	1-1/16
Fiber Length (Fibrograph):						
Upper half mean - inches	1.08	1.06	1.08	1.04	1.06	1.09
Uniformity - ratio	80	79	79	77	78	78
Fiber Fineness & Maturity:						
Micronaire - readings	4.8	4.4	4.7	4.6	4.6	4.4
Fineness (Causticaire) ug/in.	4.7	4.4	4.7	4.6	4.7	4.7
Maturity (") index	82	78	80	80	80	77
Fiber Strength (Pressley)						
Zero gauge - 1,000 p.s.i.	80	80	80	78	77	75
Zero gauge - gm. per tex	39.6	39.6	39.6	38.6	38.1	37.1
1/8 in. gauge - gm. per tex	21.7	22.3	21.2	20.9	20.4	20.7
Shirley Analyzer:						
Visible waste - %	1.3	1.4	1.3	1.2	0.8	2.2
Invisible " - %	1.1	1.0	1.2	1.4	1.1	1.1
Total nonlint cont. - %	2.4	2.4	2.5	2.6	1.9	3.3
Color of Raw Cotton:						
Reflectance - Rd.	74.3	75.0	73.5	75.3	76.4	71.5
Yellowness - +b	9.1	8.8	9.0	8.7	8.6	7.6
Color index	98	99	97	100	101	92
Sugar Content - %	0.0	0.0	0.1	0.0	0.0	0.0
Acid Alkaline Value - ph	8.9	7.8	8.6	8.5	9.0	7.7
PROCESSING RESULTS:						
Manufacturing Waste						
Picker and card - %	6.8	7.6	7.7	8.4	7.5	8.4
Neps - per 100 sq. in. card web	13	11	10	26	26	15
Yarn Skein Strength - Grey Yarn						
22s (26.8 tex) - pounds	119	115	120	109	108	113
50s (11.8 tex) - pounds	42	40	42	38	37	38
Average break factor	2359	2265	2370	2149	2113	2193
Yarn Appearance (grey)						
22s (26.8 tex) - grade	B	B	B	C+	C+	C+
50s (11.8 tex) - grade	C+	C+	C+	C+	C	C
Average yarn appear. index	105	105	105	100	95	95
Color of 22s Carded Yarn						
Grey						
Reflectance - Rd.	71.6	71.0	71.0	68.7	70.1	69.4
Yellowness - +b	12.2	12.2	11.9	10.4	10.4	10.8
Color index	103	102	101	91	94	94
Bleached						
Reflectance - Rd.	85.4	85.1	84.8	80.8	85.0	83.5
Yellowness - +b	3.5	2.7	3.1	3.3	3.2	3.6
Color index	104	106	104	94	104	99
Dyed after bleaching						
Reflectance - Rd.	26.7	27.6	26.7	27.9	28.7	27.3
Blueness - -b	26.0	25.9	26.2	25.8	25.5	25.3
Color index	105	102	105	101	98	100

(Continued)

Table 22.— (Continued)

Variety	Deltapine					
Market area	Cheneyville					
Period of harvest	1st	2nd	3rd	4th	5th	6th
RAW COTTON QUALITY:						
Classification (off. std.):						
Grade - designation	SLM	SLM	SLM	SLM	SLM	SLM
Staple length - inches	1-1/32	1-1/16	1-1/16	1-1/16	1-1/16	1-1/32
Fiber Length (Fibrograph):						
Upper half mean - inches	1.06	1.06	1.06	1.06	1.06	1.06
Uniformity - ratio	77	77	76	76	76	75
Fiber Fineness & Maturity:						
Micronaire - readings	5.0	4.7	4.6	4.4	4.2	3.6
Fineness (Causticaire) ug/in.	4.7	4.7	4.5	4.5	4.2	4.2
Maturity (") index	83	80	80	79	78	70
Fiber Strength (Pressley)						
Zero gauge - 1,000 p.s.i.	76	76	77	74	74	76
Zero gauge - gm. per tex	37.6	37.6	38.1	36.6	36.6	37.6
1/8 in. gauge - gm. per tex	19.9	20.7	20.3	20.3	21.1	20.7
Shirley Analyzer:						
Visible waste - %	1.0	1.0	1.2	1.5	1.5	1.5
Invisible " - %	0.9	0.9	1.1	1.2	1.2	1.2
Total nonlint cont. - %	1.9	1.9	2.3	2.7	2.7	2.7
Color of Raw Cotton:						
Reflectance - Rd.	71.0	70.0	74.3	74.3	75.5	72.4
Yellowness - +b	7.9	8.4	8.3	8.1	7.7	7.8
Color index	91	90	98	98	99	94
Sugar Content - %	0.0	0.0	0.1	0.0	0.0	0.0
Acid Alkaline Value - ph	8.4	8.5	8.0	8.7	8.6	7.8
PROCESSING RESULTS:						
Manufacturing Waste						
Picker and card - %	6.8	7.8	7.8	7.8	8.2	8.7
Neps - per 100 sq. in. card web	29	19	24	20	34	55
Yarn Skein Strength - Grey Yarn						
22s (26.8 tex) - pounds	100	101	108	105	105	104
50s (11.8 tex) - pounds	35	34	38	36	39	37
Average break factor	1975	1961	2138	2055	2130	2069
Yarn Appearance (Grey)						
22s (26.8 tex) - grade	B	C+	C+	C+	C	C
50s (11.8 tex) - grade	C	D+	C+	C	D+	D
Average yarn appear. index	100	90	100	95	85	80
Color of 22s Carded Yarn						
Grey						
Reflectance - Rd.	68.4	66.3	66.7	71.2	66.6	68.6
Yellowness - +b	11.6	11.9	11.6	11.3	10.5	10.5
Color index	94	91	91	99	88	91
Bleached						
Reflectance - Rd.	85.0	85.7	85.0	85.6	83.4	84.5
Yellowness - +b	2.8	2.3	3.0	2.2	3.4	2.8
Color index	106	110	105	110	100	105
Dyed after bleaching						
Reflectance - Rd.	25.1	26.7	26.8	26.0	26.0	27.9
Blueness - -b	27.2	26.1	26.6	26.7	26.0	24.5
Color index	112	105	106	108	106	96

(Continued)

Table 22.— (Continued)

Variety	Deltapine					
Market area	Delhi				Mer Rouge	
Period of harvest	1st	2nd	3rd	4th	1st	2nd
RAW COTTON QUALITY:						
Classification (off. std.):						
Grade - designation	SLM	SLM	SLM	LM	M	M
Staple length - inches	1-1/16	1-1/16	1-1/16	1-1/16	1-1/16	1-1/16
Fiber Length (Fibrograph):						
Upper half mean - inches	108	109	107	109	105	104
Uniformity - ratio	82	79	77	80	81	79
Fiber Fineness & Maturity:						
Micronaire - readings	5.2	4.7	4.4	3.4	4.4	4.6
Fineness (Causticaire) ug/in.	5.1	4.5	4.5	3.8	4.6	4.4
Maturity (") index	83	82	79	71	78	81
Fiber Strength (Pressley)						
Zero gauge - 1,000 p.s.i.	77	78	79	80	76	77
Zero gauge - gm. per tex	38.1	28.6	39.1	39.6	37.6	38.1
1/8 in. gauge - gm. per tex	21.1	21.8	21.2	19.7	19.7	20.7
Shirley Analyzer:						
Visible waste - %	2.7	2.8	1.8	3.2	0.7	0.8
Invisible " - %	1.4	1.4	1.0	1.5	1.1	1.1
Total nonlint cont. - %	4.1	4.2	2.8	4.7	1.8	1.9
Color of Raw Cotton:						
Reflectance - Rd.	69.6	73.5	73.5	71.0	74.5	75.5
Yellowness - +b	9.2	8.2	8.4	7.2	9.1	9.2
Color index	89	96	96	91	98	100
Sugar Content - %	0.0	0.0	0.0	0.0	0.1	0.1
Acid Alkaline Value - ph	9.0	8.3	8.4	8.2	8.3	8.3
PROCESSING RESULTS:						
Manufacturing Waste						
Picker and card - %	8.8	8.8	7.1	9.9	7.0	6.9
Neps - per 100 sq. in. card web	7	6	12	20	14	10
Yarn Skein Strength - Grey Yarn						
22s (26.8 tex) - pounds	105	117	111	116	109	109
50s (11.8 tex) - pounds	37	40	38	43	38	38
Average break factor	2080	2287	2171	2351	2149	2149
Yarn Appearance (Grey)						
22s (26.8 tex) - grade	B	B	B	C+	C+	B
50s (11.8 tex) - grade	C+	C+	C	D+	C	C+
Average yarn appear. index	105	105	100	90	95	105
Color of 22s Carded Yarn						
Grey						
Reflectance - Rd.	69.2	70.8	69.4	69.2	69.4	71.4
Yellowness - +b	11.8	11.0	10.3	10.2	12.8	11.4
Color index	97	98	92	91	101	100
Bleached						
Reflectance - Rd.	83.0	85.2	84.4	84.9	86.1	85.0
Yellowness - +b	3.1	2.8	3.1	3.1	2.7	2.9
Color index	100	106	103	104	109	105
Dyed after bleaching						
Reflectance - Rd.	25.0	26.7	27.9	28.5	26.2	27.6
Blueness - -b	27.7	26.7	26.2	25.9	27.3	26.2
Color index	115	107	103	101	111	103

(Continued)

Table 22.— (Continued)

Variety	Deltapine					
Market area	Mer Rouge		Minden		Opelousas	
Period of harvest	3rd	4th	1st	2nd	1st	2nd
RAW COTTON QUALITY:						
Classification (off. std.):						
Grade - designation	SLM	SLM	SLM	M	Mltgr	M
Staple length - inches	1-1/16	1-1/32	1-1/32	1-1/32	1-1/16	1-1/16
Fiber Length (Fibrograph):						
Upper half mean - inches	1.03	1.06	1.05	1.02	1.05	1.06
Uniformity - ratio	77	79	80	78	76	78
Fiber Fineness & Maturity:						
Micronaire - readings	4.4	4.0	4.6	4.6	4.6	4.9
Fineness (Causticaire) ug/in.	4.5	4.4	4.7	4.7	4.5	4.7
Maturity (") index	79	74	80	79	81	82
Fiber Strength (Pressley)						
Zero gauge - 1,000 p.s.i.	77	75	82	82	74	81
Zero gauge - gm. per tex	38.1	37.1	40.6	40.6	36.6	40.1
1/8 in. gauge - gm. per tex	20.7	20.9	21.6	20.7	19.3	21.3
Shirley Analyzer:						
Visible waste - %	1.3	1.8	2.1	1.1	1.1	1.4
Invisible " - %	1.3	1.2	1.3	0.9	1.2	1.4
Total nonlint cont. - %	2.6	3.0	3.4	2.0	2.3	2.8
Color of Raw Cotton:						
Reflectance - Rd.	74.3	74.3	75.4	76.4	70.5	73.7
Yellowness - +b	8.1	7.4	8.9	8.8	8.8	8.7
Color index	97	92	100	101	91	97
Sugar Content - %	0.0	0.0	0.1	0.1	0.2	0.0
Acid Alkaline Value - ph	8.1	8.0	8.1	8.2	7.8	8.0
PROCESSING RESULTS:						
Manufacturing Waste						
Picker and card - %	8.0	8.2	8.3	8.0	8.1	7.1
Neps - per 100 sq. in. card web	19	20	10	6	8	9
Yarn Skein Strength - Grey Yarn						
22s (26.8 tex) - pounds	107	108	115	114	92	108
50s (11.8 tex) - pounds	36	39	42	39	31	38
Average break factor	2077	2163	2315	2229	1787	2138
Yarn Appearance (grey)						
22s (26.8 tex) - grade	B	C+	B	B	B	B
50s (11.8 tex) - grade	C	C	C+	B	C+	C
Average yarn appear. index	100	95	105	110	105	100
Color of 22s Carded Yarn						
Grey						
Reflectance - Rd.	68.6	67.4	69.4	71.7	66.9	69.4
Yellowness - +b	10.6	10.7	12.4	11.6	11.1	11.4
Color index	91	89	100	101	90	96
Bleached						
Reflectance - Rd.	84.0	85.7	84.9	86.3	84.6	83.4
Yellowness - +b	3.0	2.6	3.3	3.0	3.0	2.6
Color index	103	108	104	109	104	103
Dyed after bleaching						
Reflectance - Rd.	28.2	27.8	25.7	27.6	25.5	25.3
Blueness - -b	25.7	26.5	27.4	26.3	26.8	27.4
Color index	101	104	112	104	110	113

(Continued)

Table 22.— (Continued)

Variety	Deltapine	
Market area	Opelousas	
Period of harvest	3rd	4th
RAW COTTON QUALITY:		
Classification (off. std.):		
Grade - designation	M	M
Staple length - inches	1-1/16	1-1/16
Fiber Length (Fibrograph):		
Upper half mean - inches	1.07	1.07
Uniformity - ratio	79	79
Fiber Fineness & Maturity:		
Micronaire - readings	4.8	4.5
Fineness (Causticaire) ug/in.	4.8	4.4
Maturity (") index	80	80
Fiber Strength (Pressley)		
Zero gauge - 1,000 p.s.i.	77	80
Zero gauge - gm. per tex	38.1	39.6
1/8 in. gauge - gm. per tex	20.8	21.6
Shirley Analyzer:		
Visible waste - %	1.6	1.6
Invisible " - %	1.7	1.1
Total nonlint cont. - %	3.3	2.7
Color of Raw Cotton:		
Reflectance - Rd.	76.3	74.4
Yellowness - +b	8.7	8.7
Color index	101	98
Sugar Content - %	0.0	0.0
Acid Alkaline Value - ph	7.9	8.4
PROCESSING RESULTS:		
Manufacturing Waste		
Picker and card - %	8.5	7.7
Neps - per 100 sq. in. card web	14	12
Yarn Skein Strength - Grey Yarn		
22s (26.8 tex) - pounds	110	107
50s (11.8 tex) - pounds	38	38
Average break factor	2160	2127
Yarn Appearance (grey)		
22s (26.8 tex) - grade	B	B
50s (11.8 tex) - grade	C	D+
Average yarn appear. index	100	95
Color of 22s Carded Yarn		
Grey		
Reflectance - Rd.	69.7	69.3
Yellowness - +b	11.6	11.5
Color index	97	96
Bleached		
Reflectance - Rd.	86.4	84.8
Yellowness - +b	3.0	2.8
Color index	109	106
Dyed after bleaching		
Reflectance	26.4	26.0
Blueness - -b	26.9	27.4
Color index	108	111

Table 23.—Fiber Tests and Carded Yarn Processing Test Results by Market Areas, Louisiana, 1960

Variety	Deltapine			
Market area	Homer			
Period of harvest	1st	2nd	3rd	4th
RAW COTTON QUALITY:				
Grade - designation	M	M	Mltsp	Mltsp
Staple length - inches	1-1/32	1-1/32	1-1/32	1-1/32
Fiber length (array)				
Upper quartile - inches	1.11	1.12	1.13	1.18
Coef. of var. - %	30	29	30	27
Fibers shorter than ½ in. -%	10	8	9	7
Fiber length (digested fibrograph)				
2.5% span length - inches	1.02	1.02	1.03	1.03
Uniformity ratio (50/2.5) - %	44	45	46	43
Fibers shorter than ½ in. - %	9	9	7	11
Fiber fineness & maturity				
Micronaire - reading	5.0	5.0	4.8	4.7
Fineness (Causticaire) ug/in.	5.1	4.9	4.9	5.0
Maturity (Causticaire) index	81	82	80	78
Fiber strength				
Zero gauge - 1,000 p.s.i.	84	80	77	78
Zero gauge - grams/tex	41.6	39.6	38.1	38.6
1/8 in. gauge - grams/tex	21.2	21.0	21.0	20.3
Shirley analyzer				
Visible waste - %	2.2	2.6	2.0	1.9
Total visible & invisible - %	3.2	3.9	3.0	3.1
Color of raw cotton - code	553	552	603	603
Sugar content - %	0.3	0.2	0.1	0.0
Acid Alkaline value - ph	7.7	8.0	8.6	8.5
PROCESSING RESULTS:				
Picker and card waste - %	6.8	8.6	8.2	9.7
Neps - per 100 sq. in. card web	7	7	11	8
Yarn skein strength				
22s (26.8 tex) - pounds	108	107	101	99
50s (11.8 tex) - pounds	37	38	35	35
Average break factor	2113	2127	1986	1964
Yarn imperfections				
22s (26.8 tex) - number	12	18	18	12
50s (11.8 tex) - number	10	10	13	9
Average imperfections - number	11	14	16	10
Yarn appearance				
22s (26.8 tex) - grade	B+	B+	B	B+
50s (11.8 tex) - grade	C+	C+	C+	B
Average yarn appearance - index	110	110	105	115

(Continued)

Table 23.—(Continued)

Variety	Deltapine				
Market area	Natchitoches				
Period of harvest	1st	2nd	3rd	4th	5th
RAW COTTON QUALITY:					
Grade - designation	M	M	SLM	SLM	SLMltsp
Staple length - inches	1-1/32	1-1/16	1-1/16	1-1/32	1-1/16
Fiber length (array)					
Upper quartile - inches	1.12	1.16	1.22	1.24	1.18
Coef. of var. - %	34	34	35	28	36
Fibers shorter than ½ in. -%	14	12	13	6	15
Fiber length (digested fibrograph					
2.5% span length - inches	1.00	1.07	1.07	1.04	1.07
Uniformity ratio (50/2.5) -%	43	41	41	41	39
Fibers shorter than ½ in. -%	15	15	14	14	18
Fiber fineness & maturity					
Micronaire - reading	5.0	4.6	4.6	4.8	3.8
Fineness (Causticaire) ug/in.	4.8	4.8	4.6	4.7	3.8
Maturity (Causticaire) index	82	79	79	82	76
Fiber strength					
Zero gauge - 1,000 p.s.i.	80	78	76	75	78
Zero gauge - grams/tex	39.6	38.6	37.6	37.1	38.6
1/8 in. gauge - grams/tex	20.9	19.8	20.0	20.6	22.0
Shirley analyzer					
Visible waste - %	0.8	1.0	1.6	1.4	2.2
Total visible & invisible - %	1.7	2.3	2.9	2.8	3.4
Color of raw cotton - code	553	652	602	652	702
Sugar content - %	0.0	0.0	0.0	0.0	0.0
Acid Alkaline value - ph	8.2	8.1	8.9	9.2	8.6
PROCESSING RESULTS:					
Picker & card waste - %	7.1	6.7	8.6	8.4	8.9
Neps - per 100 sq. in. card web	16	22	29	31	53
Yarn skein strength					
22s (26.8 tex) - pounds	97	102	101	95	100
50s (11.8 tex) - pounds	33	37	36	33	34
Average break factor	1892	2047	2011	1870	1950
Yarn imperfections					
22s (26.8 tex) - number	33	25	31	35	61
50s (11.8 tex) - number	20	19	22	28	34
Average imperfections - number	26	22	26	32	48
Yarn appearance					
22s (26.8 tex) - grade	C+	C	C+	C	C
50s (11.8 tex) - grade	C	D+	D+	D	D
Average yarn appearance - index	95	85	90	80	80

(Continued)

Table 23.— (Continued)

Variety	Deltapine			
Market area	Bunkie			
Period of harvest	1st	2nd	3rd	4th
RAW COTTON QUALITY:				
Grade - designation	M	M	M	SLM
Staple length - inches	1-1/32	1-1/16	1-1/16	1-1/16
Fiber length (array)				
Upper quartile - inches	1.16	1.24	1.19	1.21
Coef. of var. - %	38	33	35	38
Fibers shorter than ½ in. - %	17	11	13	15
Fiber length (digested fibrograph)				
2.5% span length - inches	1.04	1.07	1.08	1.08
Uniformity ratio (50/2.5) - %	43	43	41	41
Fibers shorter than ½ in. - %	12	12	15	13
Fiber fineness & maturity				
Micronaire - reading	5.0	4.4	4.5	4.2
Fineness (Causticaire) ug/in.	4.8	4.5	4.7	4.2
Maturity (Causticaire) index	83	79	78	79
Fiber strength				
Zero gauge - 1,000 p.s.i.	77	76	75	74
Zero gauge - grams/tex	38.1	37.6	37.1	36.6
1/8 in. gauge - grams/tex	19.6	20.7	19.8	21.8
Shirley analyzer				
Visible waste - %	0.8	1.1	1.1	1.5
Total visible & invisible - %	1.9	2.6	3.0	2.8
Color of raw cotton - code	552	552	552	602
Sugar content - %	0.0	0.1	0.0	0.0
Acid Alkaline value - ph	8.4	8.2	8.3	8.0
PROCESSING RESULTS:				
Picker & card waste - %	7.0	6.5	8.1	7.0
Neps - per 100 sq. in. card web	12	25	28	40
Yarn skein strength				
22s (26.8 tex) - pounds	96	105	97	101
50s (11.8 tex) - pounds	33	38	33	37
Average break factor	1881	2105	1892	2036
Yarn imperfections				
22s (26.8 tex) - number	22	23	26	41
50s (11.8 tex) - number	12	18	18	34
Average imperfections - number	17	20	22	38
Yarn appearance				
22s (26.8 tex) - grade	C+	C+	C+	C
50s (11.8 tex) - grade	C	C	C	D+
Average yarn appearance - index	95	95	95	85

(Continued)

Table 23.— (Continued)

Variety	Deltapine			
Market area	Shreveport			
Period of harvest	1st	2nd	3rd	4th
RAW COTTON QUALITY:				
Grade - designation	SLM	SLM	SLM	LM
Staple length - inches	1-1/16	1-1/16	1-1/32	1-1/16
Fiber length (array)				
Upper quartile - inches	1.18	1.22	1.15	1.17
Coef. of var. - %	30	29	38	35
Fibers shorter than ½ in. - %	10	7	17	13
Fiber length (digested fibrograph)				
2.5% span length - inches	1.06	1.06	1.07	1.06
Uniformity ratio (50/2.5) - %	44	42	42	41
Fibers shorter than ½ in. - %	9	13	14	15
Fiber fineness & maturity				
Micronaire - reading	5.1	4.8	4.6	4.2
Fineness (Causticaire) ug/in.	4.9	4.7	4.8	4.1
Maturity (Causticaire) index	83	81	80	80
Fiber strength				
Zero gauge - 1,000 p.s.i.	82	76	78	88
Zero gauge - grams/tex	40.6	37.6	38.6	43.6
1/8 in. gauge - grams/tex	22.4	20.5	20.9	23.1
Shirley analyzer				
Visible waste - %	1.3	1.3	1.1	2.4
Total visible & invisible - %	2.5	2.7	2.0	3.2
Color of raw cotton - code	653	653	602	701
Sugar content - %	0.0	0.0	0.0	0.0
Acid alkaline value - ph	9.0	9.1	8.3	9.2
PROCESSING RESULTS:				
Picker & card waste - %	7.4	8.2	6.9	9.3
Neps - per 100 sq. in. card web	12	21	27	31
Yarn skein strength				
22s (26.8 tex) - pounds	107	100	103	110
50s (11.8 tex) - pounds	46	35	36	39
Average break factors	2152	1975	2033	2185
Yarn imperfections				
22s (26.8 tex) - number	22	20	31	31
50s (11.8 tex) - number	17	13	24	25
Average imperfections - number	20	16	28	28
Yarn appearance				
22s (26.8 tex) - grade	B	B	C+	C+
50s (11.8 tex) - grade	C	C	C	D+
Average yarn appearance - index	100	100	95	90

(Continued)

Table 23.— (Continued)

Variety	Deltapine			
Market area	Oak Grove			
Period of harvest	1st	2nd	3rd	4th
RAW COTTON QUALITY:				
Grade - designation	M	M	SLM	SLM
Staple length - inches	1-1/32	1-1/16	1-1/16	1-1/32
Fiber length (array)				
Upper quartile - inches	1.10	1.11	1.18	1.11
Coef. of var. - %	29	32	31	29
Fibers shorter than ½ in. - %	9	10	10	9
Fiber length (digested fibrograph)				
2.5% span length - inches	1.00	1.03	1.06	1.00
Uniformity ratio (50/2.5) - %	46	45	44	42
Fibers shorter than ½ in. - %	6	8	8	14
Fiber fineness & maturity				
Micronaire - reading	5.4	5.3	4.8	5.2
Fineness (Causticaire) ug/in.	5.5	5.2	4.7	5.2
Maturity (Causticaire) index	82	82	81	82
Fiber strength				
Zero gauge - 1,000 p.s.i.	83	82	78	82
Zero gauge - grams/tex	41.1	40.6	38.6	40.6
1/8 in. gauge - grams/tex	19.6	21.6	20.1	20.6
Shirley analyzer				
Visible waste - %	0.9	1.1	1.3	1.2
Total visible & invisible - %	1.6	2.2	2.6	2.5
Color of raw cotton - code	552	552	652	652
Sugar content - %	0.1	0.0	0.0	0.0
Acid alkaline value - ph	7.9	8.3	9.0	9.2
PROCESSING RESULTS:				
Picker & card waste - %	5.6	6.0	6.4	7.4
Neps - per 100 sq. in. card web	10	7	15	11
Yarn skein strength				
22s (26.8 tex) - pounds	104	106	103	98
50s (11.8 tex) - pounds	35	38	37	34
Average break factor	2019	2116	2058	1928
Yarn imperfections				
22s (26.8 tex) - number	12	10	18	15
50s (11.8 tex) - number	6	8	11	10
Average imperfections - number	9	9	14	12
Yarn appearance				
22s (26.8 tex) - grade	B+	B+	B+	B+
50s (11.8 tex) - grade	C+	C+	C+	C+
Average yarn appearance - index	110	110	110	110

(Continued)

Table 23.— (Continued)

Variety	Deltapine			
Market area	Winnsboro			
Period of harvest	1st	2nd	3rd	4th
RAW COTTON QUALITY:				
Grade - designation	M	SLM	SLM	SLM
Staple length - inches	1	1-1/32	1-1/32	1
Fiber length (array)				
Upper quartile - inches	1.04	1.13	1.04	107
Coef. of var. - %	33	29	37	35
Fibers shorter than ½ in. - %	14	8	17	15
Fiber length (digested fibrograph)				
2.5% span length - inches	0.99	1.00	1.00	0.97
Uniformity ratio (50/2.5) - %	44	45	42	43
Fibers shorter than ½ in. - %	10	11	14	17
Fiber finenss & maturity				
Micronaire - reading	5.0	5.1	5.0	5.0
Fineness (Causticaire) ug/in.	5.1	5.1	5.0	5.3
Maturity (Causticaire) index	81	82	80	80
Fiber strength				
Zero gauge - 1,000 p.s.i.	79	82	78	79
Zero gauge - grams/tex	39.1	40.6	38.6	39.1
1/8 in. gauge - grams/tex	20.4	19.0	19.6	19.2
Shirley analyzer				
Visible waste - %	0.8	1.7	1.2	1.5
Total visible & invisible - %	1.7	2.6	2.5	2.8
Color of raw cotton - code	553	653	652	652
Sugar content - %	0.1	0.0	0.0	0.0
Acid alkaline value - ph	8.4	8.4	9.2	8.8
PROCESSING RESULTS:				
Picker & card waste - %	6.7	7.0	8.0	7.3
Neps - per 100 sq. in. card web	10	13	17	16
Yarn skein strength				
22s (26.8 tex) - pounds	99	97	94	88
50s (11.8 tex) - pounds	34	34	32	30
Average break factor	1939	1917	1834	1718
Yarn imperfections				
22s (26.8 tex) - number	15	21	19	26
50s (11.8 tex) - number	10	12	12	15
Average imperfections - number	12	16	16	20
Yarn appearance				
22s (26.8 tex) - grade	B+	B	B	C+
50s (11.8 tex) - grade	C+	C+	C	C
Average yarn appearance - index	110	105	100	95

(Continued)

Table 23.— (Continued)

Variety	Deltapine			
Market area	Ferriday			
Period of harvest	1st	2nd	3rd	4th
RAW COTTON QUALITY:				
Grade - designation	M	SLM	SLM	SLMltsp
Staple length - inches	1-1/16	1-1/16	1-1/16	1-1/16
Fiber length (array)				
Upper quartile - inches	1.21	1.19	1.23	1.26
Coef. of var. - %	34	37	31	27
Fibers shorter than ½ in. - %	12	15	9	7
Fiber length (digested fibrograph)				
2.5% span length - inches	1.05	1.07	1.05	1.06
Uniformity ratio (50/2.5) - %	43	43	40	40
Fibers shorter than ½ in. - %	12	12	17	18
Fiber fineness & maturity				
Micronaire - reading	5.0	4.6	4.6	4.0
Fineness (Causticaire) ug/in.	5.0	4.7	4.7	4.1
Maturity (Causticaire) index	81	80	79	76
Fiber strength				
Zero gauge - 1,000 p.s.i.	76	78	77	74
Zero gauge - grams/tex	37.6	38.6	38.1	36.6
1/8 in. gauge - grams/tex	22.0	20.9	20.4	20.6
Shirley analyzer				
Visible waste - %	0.8	1.0	1.6	1.6
Total visible & invisible - %	1.8	2.5	3.0	2.9
Color of raw cotton - code	552	602	652	653
Sugar content - %	0.1	0.0	0.0	0.0
Acid alkaline value - ph	7.5	8.6	8.5	8.3
PROCESSING RESULTS:				
Picker & card waste - %	6.8	7.2	7.7	9.0
Neps - per 100 sq. in. card web	10	36	13	31
Yarn skein strength				
22s (26.8 tex) - pounds	99	97	97	99
50s (11.8 tex) - pounds	34	34	34	34
Average break factor	1939	1917	1917	1939
Yarn imperfections				
22s (26.8 tex) - number	18	31	20	37
50s (11.8 tex) - number	14	16	16	27
Average imperfections - number	16	24	18	32
Yarn appearance				
22s (26.8 tex) - grade	B	C+	B	C+
50s (11.8 tex) - grade	C	C	C	D+
Average yarn appearance - index	100	95	100	90

Table 24.— Results of Classification, Fiber Tests, Carded Yarn Processing Tests and Chemical Finishing Tests for Specified Varieties of Cotton, Grown in Designated Market Areas, Louisiana 1956-57.

Variety	Stardel		
Market area	Gilliam		Shreveport
Period of harvest	1956	1957	1957
RAW COTTON QUALITY:			
Grade			
Early	M	M	SLM
Midseason	SLM	SLM	SLM
Late	SLM	LM	LM
Staple length			
Early	1-1/16	1-1/16	1-1/16
Midseason	1-1/16	1-1/16	1-3/32
Late	1-1/16	1-1/16	1-1/16
Fiber length (Fibrograph)			
Upper half mean - inches			
Early	1.06	1.07	1.06
Midseason	1.02	1.06	1.09
Late	1.03	1.07	1.06
Uniformity ratio			
Early	79	79	79
Midseason	80	79	81
Late	80	77	79
Fiber fineness and maturity			
Micronaire reading			
Early	4.1	4.4	4.4
Midseason	4.4	4.2	4.6
Late	4.5	3.7	4.6
Fineness (Causticaire) ug/inch			
Early	4.1	4.6	4.3
Midseason	4.4	4.4	4.4
Late	4.6	4.0	4.5
Maturity (Causticaire) index			
Early	77	79	80
Midseason	80	78	81
Late	79	73	80
Fiber tensile strength (Pressley)			
Zero gauge - 1,000 p.s.i.			
Early	91	89	93
Midseason	89	90	91
Late	99	83	88
Nonlint content (Shirley Analyzer)			
Early	2.3	2.0	2.5
Midseason	4.0	2.9	3.3
Late	3.0	4.2	3.9

(Continued)

Table 24.— (Continued)

Variety	Stardel		
Market area	Gilliam		Shreveport
Period of harvest	1956	1957	1957
Color of raw cotton			
Reflectance -- Rd.			
Early	75.5	77.0	76.5
Midseason	72.0	71.3	71.3
Late	72.0	68.5	68.5
Yellowness -- +b			
Early	8.5	8.4	8.0
Midseason	8.5	7.9	8.7
Late	7.6	7.4	7.4
PROCESSING RESULTS:			
Manufacturing waste			
Picker and card per cent			
Early	7.0	6.8	8.8
Midseason	9.0	8.5	9.0
Late	7.7	8.6*	10.2
Neps per 100 sq. inch card web			
Early	17	15	8
Midseason	22	9	9
Late	10	19	7
Yarn skein strength			
22s ---- pounds			
Early	127	128	135
Midseason	118	123	130
Late	123	120	124
50s ---- pounds			
Early	43	46	49
Midseason	41	44	47
Late	42	42	44
Yarn appearance			
22s ---- grade			
Early	B	B+	B
Midseason	C+	B	B
Late	B	C+	B
50s ---- grade			
Early	C	C+	C
Midseason	C	C+	C+
Late	C+	D+	C+
Average yarn appearance index			
Early	100	110	100
Midseason	95	105	105
Late	105	90	105

*Less than 5 pounds net weight fed to picker; therefore, waste results are not considered reliable.

Table 25.—Cotton: Carded Yarn Processing Tests Results for Stardel Variety by Market Area for Samples of Model Quality, Collected at Triweekly Intervals, Crop of 1960.

Variety	Stardel				
Market area	Shreveport				
Period of harvest	1st	2nd	3rd	4th	5th
RAW COTTON QUALITY:					
Grade - designation	SM	M	SLM	SLM	LM LT SP
Staple length - inches	33	34	34	34	34
Fiber length (array)					
Upper quartile - inches	1.15	1.20	1.19	1.18	1.20
Coef. of var. - %	33	30	32	32	33
Fibers shorter than ½ in. - %	11	9	11	10	11
Fiber length (digested fibrograph)					
2.5% span length - inches	1.04	1.03	1.07	1.08	1.08
Uniformity ratio (50/2.5) - %	43	46	42	41	43
Fibers shorter than ½ in. - %	13	8	12	13	11
Fiber fineness and maturity					
Micronaire - reading	5.0	4.8	4.6	4.6	4.1
Fineness (Causticaire) ug/in.	4.9	4.9	4.6	4.4	4.0
Maturity (Causticaire) index	82	81	79	82	79
Fiber strength					
Zero gauge - 1,000 p.s.i.	85	95	89	89	84
Zero gauge - grams/tex	42.1	47.0	44.1	44.1	41.6
1/8 in. gauge - grams/tex	21.4	23.5	23.1	22.8	21.9
Shirley analyzer					
Visible waste - %	0.72	1.32	2.06	2.19	2.32
Total visible and invisible -%	1.37	1.96	3.26	3.22	3.40
Color of raw cotton - code					
Reflectance	74.3	75.1	73.1	73.1	67.4
Yellowness	9.1	8.5	8.3	8.1	8.7
Sugar content	0.1	0.1	0.0	0.0	0.0
Acid alkaline value - ph	8.5	7.7	9.2	8.9	8.4
PROCESSING RESULTS:					
Picker and card waste - %	5.97	6.07	8.35	7.99	8.26
Neps - per 100 sq. in. of card web	10	14	18	15	28
Yarn skein strength					
22s (26.8 tex) - pounds	111	127	116	114	112
50s (11.8 tex) - pounds	39	46	41	40	40
Average break factor	2196	2547	2301	2254	2232
Yarn appearance					
22s (26.8 tex) - grade	110	110	100	100	100
50s (11.8 tex) - grade	100	100	90	90	90
Average yarn appearance	105	105	95	95	95
Yarn imperfections					
22s (26.8 tex) - number	17	24	31	32	27
50s (11.8 tex) - number	14	12	17	22	30

LOUISIANA AGRICULTURE

ECONOMIC TRENDS AND CURRENT STATUS

Leo Polopolus

Agricultural Economics and Agribusiness

January 1962
Bulletin No. 550

Louisiana State University and
Agricultural and Mechanical College
Agricultural Experiment Station
Charles W. Upp, Director

Preface

It should be noted that this study is not intended to provide an exhaustive analytical summary of the changes in Louisiana's agriculture during the past few decades. Certainly it does not pretend to provide accurate predictions for the future. The general purpose of this study is to review the "highlights" of Louisiana's agriculture, rather than to analyze each of the complicated economic factors underlying the results.

To colleagues Dr. F. H. Wiegmann, Dr. F. L. Corty, and Dr. J. M. Law, Department of Agricultural Economics and Agribusiness, Louisiana State University, the author is grateful for constructive review of the first draft. Appreciation is extended to Mr. C. E. Slack, State Administrative Officer, Agricultural Stabilization and Conservation Service, United States Department of Agriculture, Alexandria, Louisiana, for providing data relating to acreage allotment programs. Appreciation is also due Bill Bolton, Agricultural Economist, Farm Economics Research Division of the United States Department of Agriculture, for valuable comment.

TABLE OF CONTENTS

LOUISIANA STATE UNIVERSITY LIBRARY

Page
Introduction 5
Purpose of Study 5
Sources of Information 6
Natural Conditions Affecting Louisiana's Agricultural Production 6
Land Surface 6
Slope 6
Soils 6
Land Use 7
Climate 8
Some Economic Factors Affecting Louisiana's Agricultural Production 9
Labor 9
Capital Sources 11
Management 12
General Data on Louisiana Agriculture 13
Rural Population 13
Number of Farms 13
Farm Tenure 14
Cash Receipts From Farm Marketings 15
Cash Receipts From Farm Crops, Livestock, and Livestock Products 15
Crops of National Importance 19
Type of Farming Areas in Louisiana 19
Type of Farming Areas and Major Agricultural Products . . 20
Louisiana's Crops: Trends in Acreage, Yield, Production, and Location of Production 22
Field Crops 22

TABLE OF CONTENTS (Continued)

Page

  Vegetable Crops 32
  Nursery and Greenhouse Products 36
  Fruits and Tree Nuts 37

Louisiana's Livestock: Trends in Numbers, Production, and Location of Production 41
  All Cattle and Calves 41
  Milk and Milk Cows 42
  All Hogs and Pigs 45
  Sheep and Lambs 45
  Eggs 46
  Commercial Broilers 47

Louisiana's Forests 47

The Contribution of Agriculture to Louisiana's Manufacturing Industries 49
  Establishments, Employees, and Payroll 49
  Value Added 49
  New Capital Expenditures 50
  Summary 52

Technological Changes in Louisiana Agriculture 53
  Adoption of New Technology 53
  The Economics of Technological Change 55
  Some Sociological Aspects of Technological Change 56

Impact of Government Programs and Policies 56
  Acreage Controls 56
  Conservation Reserve of the Soil Bank 59
  Government Programs to Stimulate Economic Development in Louisiana Agriculture 59

Summary and Conclusions 62

Louisiana Agriculture: Economic Trends and the Current Status

LEO POLOPOLUS*

Introduction

Agriculture has traditionally dominated Louisiana's economic history. Most of the state's economic resources have been devoted to or closely associated with products of the soil. This is still true despite recent increases in the output of nonagricultural products. Louisiana agriculture has experienced a general rise in output over time. Total cash farm income in 1959 approached 400 million dollars, the highest on record except for 1952 and 1953. With the trend to fewer farmers, an increase in the average size of farm, and larger capital investment, agriculture in Louisiana over the last 15 or 20 years has emerged on a highly mechanized, commercial, and more efficient basis. This has strengthened the position of agriculture in the state's economy.

Purpose of Study

The purpose of this study is to review some of the economic developments in Louisiana's agriculture, particularly since 1930, and to evaluate its current status. The publication considers the following questions: What are the natural conditions affecting Louisiana's agricultural production? What changes have occurred in rural population, farm tenure, and the relative importance of the various farm products? What are the major types of farming areas in Louisiana, and what are the important agricultural products of each area? What have been the trends in the acreage, yield, and production of Louisiana's crops? To what extent have there been shifts in the location of production of crops and livestock? What has happened to livestock numbers and the production of livestock products since 1930? What is the nature and extent of Louisiana's forest industry? What is the contribution of the food, fiber, and forestry manufacturing industries to the Louisiana economy in terms of employees, payroll, establishments, and value added? To what extent has new technology been adopted and proliferated in Louisiana agriculture? What has been the impact of government programs upon Louisiana agriculture?

---

*Assistant Professor, Department of Agricultural Economics and Agribusiness, Louisiana State University.

Sources of Information

This study draws heavily upon data published by various agencies. The major sources include publications from the following: U. S. Census of Agriculture—basic data relating to shifts in the location of agricultural production; U. S. Census of Manufacturing—agricultural and forestry manufacturing data; U. S. Crop Reporting Service—data on cash receipts from farm marketing; U. S. Weather Bureau—climatic data; Louisiana Agricultural Experiment Station—acreage, yield, and production data; Louisiana Division of Employment Security—farm labor data.

Natural Conditions Affecting Louisiana's Agricultural Production

Land Surface

Total area of the state of Louisiana comprises 48,523 square miles, or approximately 31 million acres. Lakes, rivers, bayous, and other internal waterways account for 3,361 square miles of the total area, leaving 45,162 square miles, or approximately 29 million acres, of soil surface.

Slope

The topography of the state may be described as a gentle slope which begins with an elevation of about 400 feet near the northern boundary and ends with below-sea-level coastal marshes in the south. Average elevation of the state is 100 feet above sea level. The state's maximum elevation is 535 feet in Bienville Parish, and the lowest elevation is —5 feet in Orleans Parish.

Soils

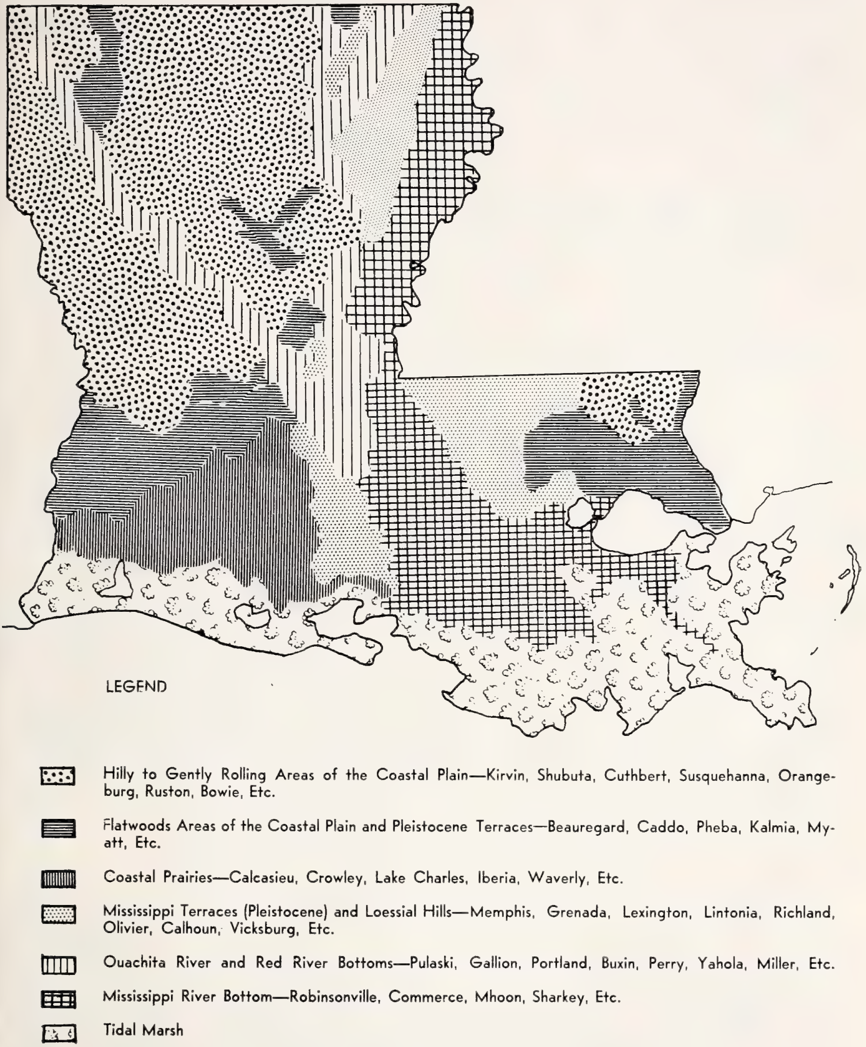
The state possesses soil of varying degrees of fertility. Much of it is low in natural fertility, particularly the soils in the northern and western hill sections of the state.

Soils in the delta areas have a high plant nutrient level. Principal delta areas are along the Mississippi, Red, and Ouachita Rivers. Soil deposits of the Red River, in keeping with their origin, are reddish brown. Those of the Mississippi River are black residues from the Midwest. Although these soils are quite productive, some are subject to flooding.

Prairie lands in the southwestern part of the state are made up of clay and clay loam soils with impervious subsoils. This soil, combined with an adequate water supply, is ideal for rice production (Figure 1).

Soil of the coastal marsh area is of a peat-like quality but, because of the threat of tidal waters, is presently of little agricultural significance. However, drainage and low level construction, as in Cameron Parish, may reclaim some of this land.

FIGURE 1.—General Soil Areas or Associations of Louisiana.
(Compiled by M. B. Sturgis)


LEGEND
Hilly to Gently Rolling Areas of the Coastal Plain—Kirvin, Shubuta, Cuthbert, Susquehanna, Orangeburg, Ruston, Bowie, Etc.
Flatwoods Areas of the Coastal Plain and Pleistocene Terraces—Beauregard, Caddo, Pheba, Kalmia, Myatt, Etc.
Coastal Prairies—Calcasieu, Crowley, Lake Charles, Iberia, Waverly, Etc.
Mississippi Terraces (Pleistocene) and Loessial Hills—Memphis, Grenada, Lexington, Lintonia, Richland, Olivier, Calhoun, Vicksburg, Etc.
Ouachita River and Red River Bottoms—Pulaski, Gallion, Portland, Buxin, Perry, Yahola, Miller, Etc.
Mississippi River Bottom—Robinsonville, Commerce, Mhoon, Sharkey, Etc.
Tidal Marsh

Land Use

For 1959 it was estimated that 10,347,328 acres, or 35.8 per cent of the state's land area, was in farms. This figure represents a reduction of over one million acres from the 11,441,343-acre total (or 39.6 per cent) reported for 1954. Inspection of land use data for the period 1919-1959 shows that there has been a general *increase* in total acreage devoted to pastures and a *decrease* in acreage devoted to crops. Acreage devoted to cropland dwindled to 23.5 per

TABLE 1.—Louisiana: Farm Land Use, 1959

Category	Total acreage	Per cent of total farmland
Cropland		
Harvested	2,426,267	23.5
Not harvested and not pastured	448,570	4.3
Subtotal	2,874,837	27.8
Pasture		
Cropland used only for pasture	2,033,024	19.7
Open	1,689,433	16.3
Woodland	1,749,694	16.9
Subtotal	5,472,151	52.9
Woodland not pastured	1,463,584	14.1
Other	536,756	5.2
Total	10,347,328	100.0

Source: Compiled from 1959 Census of Agriculture, preliminary data.

cent of total farm land in 1959, while land devoted to pasture reached a new high of 52.9 per cent for the same year (Table 1).

Since farm land accounts for approximately one-third of the total land area of the state, what can be said of the use of the remainder? Approximately three-fourths of it (12.2 million acres) is devoted to industrially owned forests. Another large segment consists of coastal or tidal marsh lands, usually not suitable for agricultural production but valuable in terms of furs and subsurface minerals. The balance falls into a miscellaneous category, including such uses as national forests, state, parish and municipal lands, industrial sites, residential areas, and waste land.

Climate

The climate of Louisiana is considered semi-tropical. Major factors influencing climate include: (1) the proximity to the Gulf of Mexico; (2) the subtropical latitude; and (3) the network of bays, bayous, and lakes located throughout the state.

Precipitation—Louisiana has one of the highest annual rates of rainfall of all the states. The annual state average is 55 inches. The range is from 46 inches in the northwest corner of the state (Caddo Parish) to 66 inches in the coastal area (parts of St. Mary, Assumption, Terrebonne, and Lafourche parishes). Summer precipitation ranges from 9 inches in the northwest to 22 inches in the southwest. Moist tropical air results in almost daily showers in coastal parishes in the summer. However, shower activity diminishes with distance from the Gulf of Mexico toward the northern parishes. Winter precipitation is heaviest in the northeast (East and West Carroll parishes) and diminishes with distance toward the lower delta area.

Fall is generally the driest season of the year, averaging about 10 inches of rainfall. Although Louisiana is one of the wettest states, droughts occur periodically, especially in summer and fall.

Temperature—Temperature is sufficiently mild to permit a relatively long growing season throughout the state. The length of growing season ranges from 220 days in the extreme north to 320 days in the extreme southeast. Mean annual temperature is 66° F. in the northern part of the state and 69° F. for the southern part. July is the warmest month of the year, with an average temperature of 83° F. in the northwest and 81° F. in the southeast. January is the coldest month, with cool temperatures averaging 49° F. in the northwest and north central and 57° F. in the southeast. The southern portion of the state is cooler than the northern part during the summer but warmer than its counterpart in the winter. This reversal of temperature distribution is due primarily to the almost daily showers in parishes near the Gulf in the summer.

Temperatures above 110° F. and below 0° F. are very rare in Louisiana. The highest temperature was 114° F., August 10, 1936, at Plain Dealing, in the northwest area, while the lowest temperature recorded was —16° F., February 13, 1899, at Minden, in the north central area.

In summary, climatic conditions in Louisiana tend to foster agricultural production because of:

1. Mild and short winters
2. Abundant precipitation
3. Long growing season
4. Freedom from extreme heat

Some Economic Factors Affecting Louisiana's Agricultural Production

Labor

Family labor accounts for a large portion of Louisiana's agricultural labor. Approximately 75 per cent of the total number of farms in 1959 were of the ownership or part ownership type. In this situation the farmer is both a decision-maker and a source of farm labor.

In addition to the family farm labor force, slightly more than 16,000 persons in the state were classed as hired year-round farm workers in 1960. Also, approximately 90,000 persons are available during the year for seasonal or temporary farm work. The general characteristics of the hired farm labor supply differ with the various crop activities. In 1960, women accounted for approximately 75 per cent of the hired cotton labor, while 15 per cent was provided by persons of school age. Hired cotton workers were predominantly

TABLE 2.—Hired Farm Workers in Louisiana

Commodity	Male	Female	Youth	Race
		Per cent		
Cotton	10	75	15	Negro
Sugar cane	75	25	..	Almost 100% Negro
Strawberries	70	30	..	70% Negro
Tung nuts	30	70	..	Almost 100% Negro
Sweet potatoes	25	60	15	Predominately Negro
All other crops	15	75	10	85% Negro

Source: Compiled from **Louisiana, 1960, Annual Agricultural and Food Processing Report,** ES-225, Baton Rouge: Louisiana Division of Employment Security, 1960, p. 6.

Negroes. The sugar cane laborers were composed of 75 per cent males and 25 per cent females. Practically all of the hired cane workers were Negro. (For other crops, see Table 2.)

There is both an out-migration of Louisiana farm workers to other states and an in-migration of workers from other states into Louisiana. The out-migration of Louisiana-based workers increased from 1959 to 1960. In 1960, 2,934 Louisiana residents migrated to other states for seasonal farm work compared with only 1,428 persons in 1959. Louisiana migrants worked principally in the states of Michigan, Wisconsin, Illinois, Kentucky, Indiana, and Washington.[1] Most of Louisiana's migrants reside in the southern part of the state.

Migratory workers coming to Louisiana from other states do so primarily to harvest strawberries and tung nuts. No Puerto Rican contract workers or foreign workers are employed in Louisiana. A peak number of 4,700 migrants, including both intra-state and inter-state migrants, were employed in Louisiana in 1961.

Cotton is the largest employer of farm labor in Louisiana (Table 3). Acreage of cotton mechanically harvested has tended to level out at 55 to 60 per cent of total acreage. The impact of labor-saving machines has shortened the length of the crop activity periods rather than actually displaced *large* amounts of labor. It is thus expected that cotton will continue to require a relatively large labor supply.

Because of mechanization and other advances in technology, the number of sugar cane field workers has declined over time, particu-

---

[1] There are three basic migration patterns. In one pattern agricultural workers from Louisiana participated in asparagus, hops, and apple harvests in the state of Washington. The second pattern begins with the Louisiana strawberry harvest, followed by the Kentucky strawberry harvest and then the fruit and vegetable harvests in Michigan, Indiana, Illinois, Wisconsin, Ohio, and Virginia. These workers then return to Louisiana to harvest tung nuts. The third pattern begins in Florida, and to a limited extent continues to Michigan, Indiana, Illinois, Wisconsin, and Ohio to harvest fruits and vegetables.

TABLE 3.—Distribution of Labor Use, by Selected Commodities, Louisiana, 1959-1960

	Peak number of hired workers	
Activity	1959	1960
Cotton cultivation	22,650	13,375
Cotton harvest	28,900	25,275
Sugar cane planting	2,100[a]	2,100
Sugar cane harvest	6,000	5,675
Strawberry harvest	7,800	7,500
Tung nut harvest	2,000	2,900
Sweet potato harvest	500	500

Source: Compiled from **Louisiana, 1960, Annual Agricultural and Food Processing Report,** ES-225, Baton Rouge: Louisiana Division of Employment Security, 1960, p. 6.

[a] Estimated.

larly since 1950. However, the currently available local labor force is insufficient to meet the requirements of growers, particularly for cane planting, which is still done by hand. Almost complete mechanization has diminished the seasonal labor requirements for rice. As long as strawberries and tung nuts are harvested by hand, the need for an adequate labor supply will continue for these crops.

Wage Rates—Average farm wage rates have pushed steadily upward in recent years. The Louisiana farm wage rate, July 1, 1960, was $4.50 per day with house furnished; $4.90 per day without board or room. The average hourly rate for July, 1960, was 62 cents without board or room. The 62-cent hourly wage for July, 1960, was one of the lowest in the United States. However, South Carolina, Tennessee, Alabama, and Mississippi had lower farm wage rates. The United States hourly wage rate (without board and room) for July, 1960, was $1.02.

Although the Louisiana farm wage is quite low relative to the United States average, there is considerable variation in the wage rate, depending upon the nature of the farm job and the skills required. In general, wages increase as the mechanical skill requirements advance. Also, for many large Louisiana farms perquisites for cropper labor are substantial. For large-scale cotton farms in the Mississippi Delta the total value of perquisites for cropper labor was $428 per farm in 1959. Perquisites for cropper labor on large-scale Delta cotton farms, however, have declined substantially from the 1947-1949 average of $2,558 per farm.

Capital Sources

Farmers in Louisiana have several alternatives for securing farm loans. Federal Land Banks, Production Credit Associations, the Farmers' Home Administration, and the Rural Electrification Administration are government or quasi-government lending institutions. Life insurance companies and commercial banks are two

TABLE 4.—Farm Mortgage Loans: Selected Lender Groups, Louisiana, 1958-1960

	1958	1959	1960
		$1,000	
Federal Land Banks	25,505	28,607	33,132
Life insurance companies	21,743	22,874	24,061
Farmers' Home Administration	10,121	11,465	12,396
All others[a]	68,990	74,709	80,722
Total	126,359	137,655	150,311

Source: U.S. Department of Agriculture, **Agricultural Statistics**, 1959 and 1960.

[a] Commercial banks, trust companies, individuals, mortgage and investment companies, savings and loan associations, plus other miscellaneous lenders.

major types of private lending institutions. In 1960 the total amount of farm mortgage loans outstanding reached $150.3 million for Louisiana. Only 16 states had a lower figure for that year. Of Louisiana's 1960 total, 22 per cent was accounted for by the Federal Land Bank. (See Table 4.)

The average interest rate on farm loans outstanding in the Delta States of Arkansas, Mississippi, and Louisiana was 5.3 per cent in 1959, compared with a national average of 4.9 per cent. Only the Southeast region of the United States had a higher rate (i.e., 5.7 per cent). The interest rate for the Delta States has pushed steadily upward from 4.6 per cent in 1944.

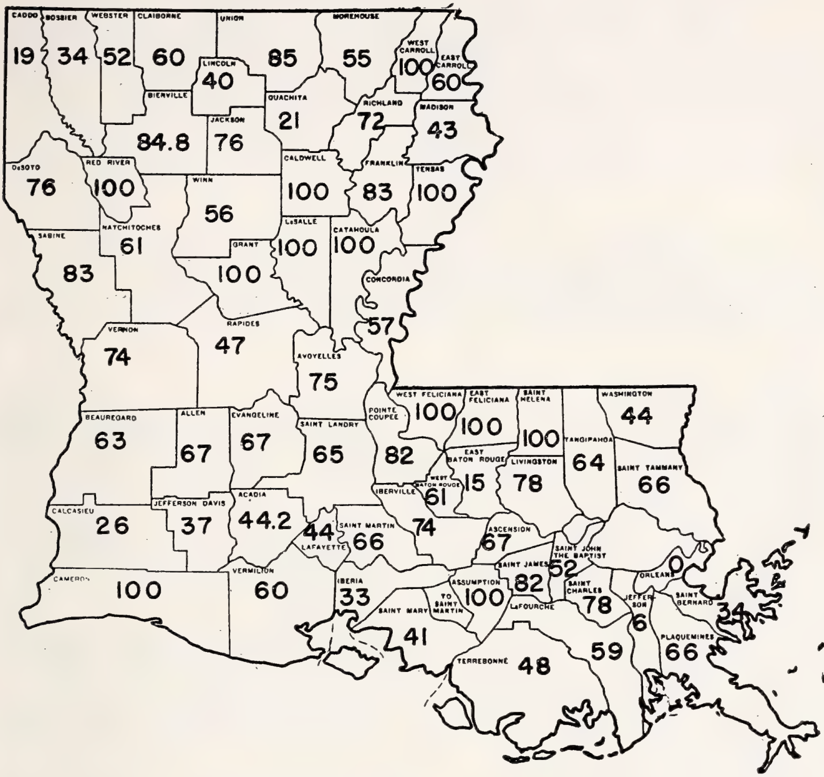
Management

Management is a resource, just as land, labor, and capital are resources. The farmer is both a decision-maker or manager, and laborer. Although the labor function may be measured empirically, the management function cannot be definitively measured. Hence, it is rather difficult to make any quantitive assessment of farm management ability in Louisiana. It is also difficult to generalize for the whole state, since there are numerous strata of managerial ability on Louisiana farms. Managerial ability is generally quite low on low production, low income farms. Among the family-sized, commercial farms there is great variation in managerial ability. However, because of the general improvement in educational training in the past decade, it appears evident that the number of good managers has increased over time. There also appears to be a low, yet positive, correlation between technological change and managerial ability.[2] Such a low correlation can be rationalized on the basis that farmers really learn new labor functions rather than improve managerial ability when adopting mechanical innovations.

---

[2] The author is indebted to Bill Bolton, Agricultural Economist, U. S. Department of Agriculture, Farm Economics Research Division, Baton Rouge, Louisiana, for suggesting this point.

FIGURE 2.—Louisiana: Rural Population As a Per Cent of Total Population, by Parishes, 1960.



General Data on Louisiana Agriculture

Rural Population

The 1960 Census classified approximately 37 per cent of Louisiana's population of 3,257,022 as rural. Slightly over one million persons resided in sparsely populated rural areas. The Census defines rural population to include not only farmers but also persons residing in rural areas but engaged in nonfarm activities.

Typically rural parishes—those with a rural population of at least 70 per cent of total population—are located in all major areas of the state.[3] (See Figure 2.)

Number of Farms

Since the mid-1930's, the total number of farms has been declining rapidly in Louisiana. The rate of decrease, however, has

---

[3] Arbitrary definition by the author.

TABLE 5.—Number of Farms and Decreases in Farm Numbers in Successive Five-Year Periods, Louisiana, 1935-1959

Year	Total number farms	Decrease in number from previous five-year period
1935	170,216	......
1940	150,007	20,209
1945	129,295	20,712
1950	124,181	5,114
1954	111,127	13,054
1959	85,573[a]	25,554

Source: Compiled from Censuses of Agriculture, 1935-1959.

[a] Adjusted for changes in the definition of a farm. The 1959 Census of Agriculture records only 74,438 farms under a narrower definition. The figure 85,573 represents what the total would have been under the 1954 definition.

varied considerably within successive five-year intervals. The most dramatic decline in farm numbers occurred during the five-year period 1954-1959. In that period there was an actual decrease of approximately 25,500 farms (Table 5).

Part of the decline in farm numbers is due to real decreases in the number of sharecroppers, as well as decreases in sharecroppers owing to changes in Census definition. There has been considerable farm consolidation by owners—a structural change from sharecropping to wage paying with the same labor. Hence, much of the decline in the number of farms in Louisiana is fictitious. The same farm unit is still there, operated now by hired labor rather than sharecroppers. But now this unit is counted as one farm rather than several.[4]

The trend to fewer farms in Louisiana is consistent with the general decrease in the number of farms throughout the United States.

In 1959 over half of Louisiana's farms were part-time and residential. The 12,497 commercial farms with sales exceeding $5,000 in farm products represented 16.8 per cent of the total number of farms. These farms, however, contributed the bulk of Louisiana's agricultural sales.

Farm Tenure

Farm tenure refers to the type of ownership or claim to land. Examples of these types are full owners, part owners, managers, and tenants. Tenants may be further classified as cash tenants, share tenants, or sharecroppers.

For Louisiana the dominant form of tenure is full ownership, which in 1959 accounted for 59.5 per cent of all farms. Part owners and full owners together accounted for approximately three-fourths of all farms. The evidence since 1930 indicates that there is a strong trend toward self-owned farms rather than tenant operated farms. Tenants of all types decreased from a high of 108,377 in 1935 to only 18,302 in 1959. Most noticeable has been the decrease in the number of Negro sharecroppers. In 1959 tenants of all types represented only one-fourth of all farms, whereas in 1935 approximately two-thirds of Louisiana's farms were tenant operated. The major tenure classes for 1959 and 1954 are shown in Table 6.

---

[4] Fred H. Wiegmann, "Some Implications From the 1959 Census of Agriculture," **Louisiana Rural Economist**, May 1961, p. 4.

TABLE 6.—Farm Tenure, Louisiana, 1954-1959

	1954		1959	
Tenure of operator	Number of farms	Per cent of total	Number of farms	Per cent of total
Full owners	59,956	54.0	44,251	59.5
Part owners	12,801	11.5	11,410	15.3
Managers	475	0.4	475	0.6
All tenants	37,895	34.1	18,302	24.6
Total	111,127	100.0	74,438	100.0

Source: Compiled from Censuses of Agriculture, 1954, 1959.

Cash Receipts from Farm Marketings

Total cash farm income from farm marketings and government payments approached $400 million in 1959. In only two years—1952 and 1953—has total cash farm income exceeded the $400 million mark (Table 7). The figure for 1959 also represents a slight recovery over conditions in 1957, when total cash farm income dropped to its lowest level since 1950.

Cash receipts from crops contributed approximately 59 per cent of the total in 1960 (Table 8). Livestock and livestock products accounted for 37 per cent, and the remainder (3.9 per cent) was represented by government payments. The increase in the relative importance of livestock and livestock products during the last 30 years is shown in Table 8.

Cotton accounted for the largest portion of total cash farm income in 1960, followed by cattle and calves, rice, sugar cane, and dairy products in that order. The distribution of cash farm income, by commodities, for 1960 is shown in Table 9.

Cash Receipts from Farm Crops, Livestock, and Livestock Products

On the basis of cash receipts of Louisiana farmers in 1959, cotton lint regained its number one position as the leading farm commodity. Cotton lint has traditionally held this lead but relinquished

TABLE 7.—Cash Receipts from Farm Marketings and Government Payments, Louisiana, 1924-1960

Year	Cash receipts from farm marketings	Government payments	Total cash farm income
	....	$1,000,000	....
1924	121.5	....	121.5
1925	158.7	....	158.7
1926	134.6	....	134.6
1927	125.9	....	125.9
1928	136.3	....	136.3
1929	161.8	....	161.8
1930	108.2	....	108.2
1931	82.8	....	82.8
1932	61.3	....	61.3
1933	64.8	5.0	69.8
1934	88.3	7.6	95.9
1935	106.2	20.4	126.6
1936	129.0	5.4	134.4
1937	121.3	7.2	128.5
1938	107.2	17.6	124.8
1939	109.6	21.2	130.8
1940	93.1	21.9	115.0
1941	117.4	16.8	134.2
1942	184.5	9.8	194.3
1943	241.5	17.4	258.9
1944	237.6	17.0	254.6
1945	258.2	12.8	271.0
1946	255.5	11.8	267.3
1947	335.4	9.1	344.5
1948	354.5	8.6	363.1
1949	340.6	9.1	349.7
1950	324.9	11.4	336.3
1951	384.7	11.6	396.3
1952	430.2	9.5	439.7
1953	401.2	6.7	407.9
1954	379.8	11.3	391.1
1955	375.9	10.3	386.2
1956	370.2	13.1	383.3
1957	338.4	21.6	360.0
1958	359.1	29.7	388.8
1959	385.1	13.7	398.8
1960	371.3	15.1	386.4

Source: J. P. Montgomery, **Agricultural Statistics for Louisiana, 1909-1957**, Louisiana Agricultural Experiment Station, Bul. No. 519, December 1958; U.S. Department of Agriculture, Economic Research Service, **Farm Income**, FIS-183 Supplement, Washington, August 1961.

it in 1957 and 1958 when cattle and calves accounted for the greatest portion of the state's total cash farm income. As late as 1950, cattle and calves ranked fourth in cash receipts behind cotton, rice, and sugar cane for sugar. Acreage controls in rice, cotton, and sugar cane have given impetus to the rise of the cattle industry. (See Table 10 for the changes in rank that occurred for the 11-year period 1950-1960.)

TABLE 8.—Distribution of Louisiana Cash Farm Income Between Crops, Livestock, and Government Payments, 1930, 1940, 1950, and 1960

Year	Per cent of total cash farm income from			
	Crops	Livestock and livestock products	Government payments	Total
1930	77.5	22.5	0	100.0
1940	58.1	22.9	19.0	100.0
1950	67.8	28.8	3.4	100.0
1960	59.1	37.0	3.9	100.0

Source: Compiled from J. P. Montgomery, **Agricultural Statistics for Louisiana, 1909-1957**, Louisiana Agricultural Experiment Station, Bulletin No. 519, December 1958; and U.S. Crop Reporting Service, Alexandria, Louisiana.

TABLE 9.—Distribution of Cash Farm Income Received by Farmers, Louisiana, by Commodities, 1960

Item	Cash receipts (1,000 dollars)	Per cent of total
Crops		
Cotton and cottonseed	82,632	21.4
Rice	57,586	14.9
Sugar cane, sugar and syrup	38,208	9.9
Fruits, nuts, and vegetables, Total	22,995	5.9
Soybeans	7,741	2.0
Sweet potatoes	7,712	2.0
Other crops[a]	11,519	3.0
All crops	228,393	59.1
Livestock and Livestock Products		
Cattle and calves	67,384	17.4
Dairy products	37,808	9.8
Broilers	10,498	2.7
Eggs	15,407	4.0
Hogs	6,848	1.8
Other[b]	4,913	1.3
All livestock and livestock products	142,858	37.0
Government payments	15,100	3.9
Total	386,351	

Source: U. S. Department of Agriculture, Economics Research Service, **Farm Income**, FIS-183 Supplement, August, 1961, pp. 84-85.

[a] Corn, farm forest products, nursery and greenhouse, wheat, hay, oats, and other miscellaneous products.

[b] Sheep and lambs, turkeys, chickens, other poultry, bees, beeswax, honey, horses and mules, wool, rabbits.

TABLE 10.—Rank in Cash Receipts from Farm Crops, Livestock, and Livestock Products, Louisiana, 1950-1960

Product	Year										
	1950	1951	1952	1953	1954	1955	1956	1957	1958	1959	1960
Top Five											
Cotton lint	1	1	1	1	1	1	1	2	3	1	1
Cattle and calves	4	3	3	3	3	3	3	1	1	2	2
Rice	2	2	2	2	2	2	2	3	2	3	3
Dairy products	5	4	5	5	5	5	5	4	4	4	4
Sugar cane for sugar	3	5	4	4	4	4	4	5	5	5	5
Others of Importance											
Chickens (and broilers)	12	14	12	16	10	6	9	7	6	6	7
Eggs	8	9	9	9	9	7	7	9	7	7	6
Hogs	6	6	8	7	6	9	8	6	9	8	11
Cottonseed	7	7	7	6	7	8	6	10	11	9	10
Soybeans	18	18	17	18	17	14	15	12	13	10	8
Pecans	15	13	15	13	14	11	17	17	17	11	17
Sweet potatoes	9	8	6	8	8	10	10	8	8	12	9
Commercial vegetables	11	11	10	11	12	16	14	13	10	13	12
Forest products	13	12	13	12	13	12	11	11	12	14	13
Corn	17	17	19	20	18	13	13	15	15	15	14
Strawberries	10	10	11	10	11	15	12	14	14	16	15
Greenhouse, nursery	16	15	16	14	15	17	16	16	16	17	16
Sugar cane for syrup	14	16	14	15	16	18	18	19	18	18	19
Wheat	..	..	..	..	..	..	..	..	..	19	18
Hay	19	19	20	19	19	19	19	18	18	20	20
Irish potatoes	20	20	..	..		..	20	..	..	..	..
Tung nuts	..	..	18	17	..	..	..	20	20	..	..
Oats	..	..	..	..	20	20	..	..	..	..	..

Source: U. S. Crop Reporting Service, Alexandria, Louisiana.

In addition to the increase in the relative importance of cattle and calves, soybeans and wheat have noticeably augmented their relative positions since 1953. Commodities showing relative declines in position since 1953 are strawberries and sugar cane for syrup. Most Louisiana farm products, however, demonstrate a variable pattern of importance, particularly pecans, cottonseed, commercial vegetables, hogs, and corn (Table 10).

Crops of National Importance

For some crops Louisiana ranks high among all states. In 1957, Louisiana ranked first in volume of production of sugar cane for sugar and seed, sugar cane for syrup, sweet potatoes, and spring strawberries for fresh market. Louisiana is the only domestic producer of perique tobacco, a unique and rare tobacco marketed in the United States and international markets and used primarily for the purpose of blending in pipe tobacco mixtures. Louisiana is also the third largest producer of rice and tung nuts, and ninth among all states in the production of both cotton lint and cottonseed.

Type of Farming Areas in Louisiana

Both economic and physical forces affect the organization and location of Louisiana agriculture. The economic forces of economies of scale and comparative advantage working[5] in a given complex of physical and biological factors such as climate, soils, topography, and vegetative cover have led to a wide diversity of crop and crop-and-livestock systems.

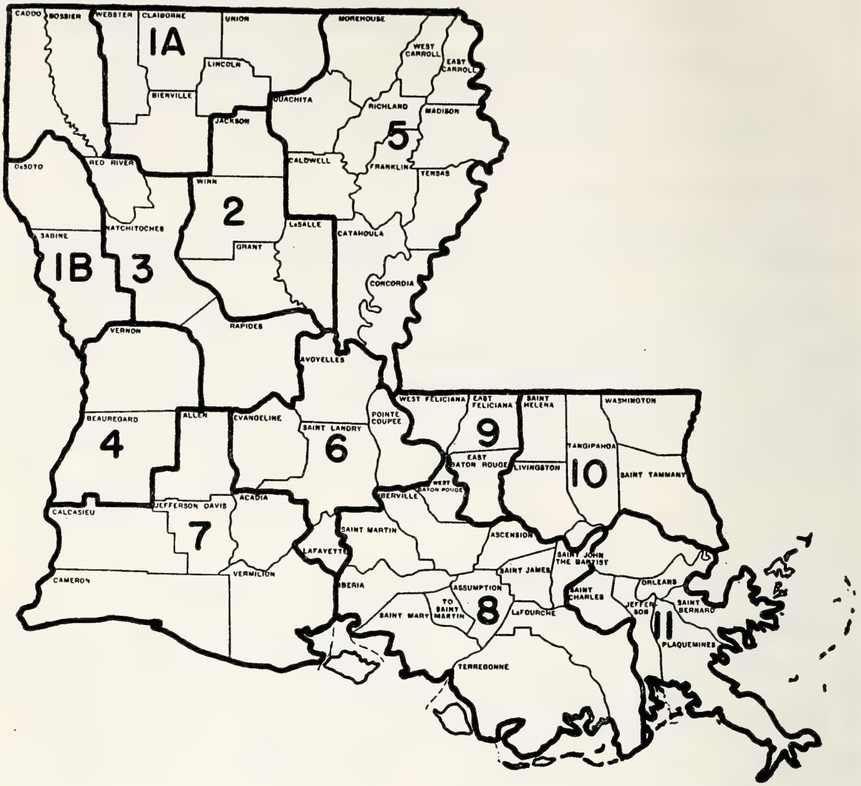
A type of farming area is an area consisting of a similar pattern of agricultural production. Twelve such areas were delineated for Louisiana on the basis of physical resources and enterprise mix, as shown in Figure 3.

The boundaries identified in Figure 3, however, do not precisely define "type of farming" areas since they are constructed along political boundaries (i.e., parish boundaries). This imposes a limitation since sharp breaks in topography and soil occurring within a given parish are not reflected in the map. Generally, where soils and topography change sharply, so do types of farming. However, published data for a more refined delineation are not readily available.

---

[5] "Economies of scale" refers to the economic factors associated with increases in size of operation which result in lower unit costs of production. "Comparative advantage" refers to the uniqueness of an area which gives it a relative advantage in the production of some commodity. Agricultural regions may also specialize in the production of farm products for which they have either the least disadvantage, or greatest absolute advantage.

FIGURE 3.—Type of Farming Areas, Louisiana, 1959.



Type of Farming Areas and Major Agricultural Products[6]

Each type of farming area is characterized by a different set of agricultural enterprises. For given areas, particular enterprises occupy major importance as a source of farm income. Also, agricultural commodities such as rice, sugar cane, tung nuts, and oranges are each produced essentially in one area of the state, or otherwise concentrated into relatively few areas because of their relatively narrow range of technical requirements such as type of soil or weather limitations (Table 11). Major enterprises typically found in the respective type of farming areas are summarized below.

1A. Upland Louisiana Timber Area—*Timber, peaches, broilers,* eggs, commercial vegetables, chickens, cotton, milk cows, hogs and pigs, hay, Irish potatoes, corn for grain.

1B. Northwest Louisiana Hill Area—*Timber, broilers,* milk cows, cattle and calves, hay, cotton.

---

[6] Italicizing indicates the most important cash products in the area.

TABLE 11.—Percentage Concentration of Total Crop Acreage, Number of Fruit Trees, and Livestock, by Type of Farming Areas, Louisiana, 1959

Commodity	Unit of measure	Type of farming area											
		1A	1B	2	3	4	5	6	7	8	9	10	11
		Per cent of state total[a]											
Field Crops													
Corn for grain	(Acres)	5.3	....	....	9.7	....	26.4	27.5	....	12.5	....	7.3	....
Oats harvested	(Acres)	..	....	....	15.5	....	60.5	....	9.0	....	6.0	....	....
Soybeans (beans)	(Acres)	..	....	....	....	....	85.0	10.1	....	....	....	....	....
Hay	(Acres)	6.1	....	....	19.1	....	17.3	15.0	12.6	7.8	4.7	7.5	....
Cotton	(Acres)	..	....	....	18.9	....	52.6	18.3	....	....	....	....	....
Rice	(Acres)	..	....	....	....	....	....	14.3	79.9	....	....	....	....
Cane for sugar	(Acres)	..	....	....	....	....	....	7.1	....	89.5	....	....	....
Cane for syrup	(Acres)	..	....	....	....	....	....	17.5	25.5	43.8	....	5.2	....
Other Crops													
Sweet potatoes	(Acres)	..	....	....	....	....	5.3	69.3	10.1	....	6.9	....	....
Irish potatoes	(Acres)	5.6	....	....	5.2	....	6.2	18.0	....	41.4	9.1	6.2	....
Commercial vegetables	(Acres)	9.2	....	....	9.6	....	4.7	6.9	....	28.2	5.1	13.8	15.3
Nursery and greenhouse	(Dollar Sales)	*	*	*	11.5	....	....	12.5	*	*	8.4*	27.6*	24.9
Fruits and Tree Nuts													
Peaches	(Trees)	59.3	....	6.0	....	....	24.5	....	....	....	....	....	....
Pecans	(Trees)	..	....	5.0	40.7	....	20.4	7.8	....	6.1	5.4	....	....
Oranges	(Trees)	..	....	....	....	....	....	....	....	....	....	....	92.4
Tung	(Trees)	..	....	....	....	....	....	....	....	....	....	99.0	....
Strawberries	(Acres)	..	....	....	....	....	....	....	....	....	....	98.0	....
Livestock and Livestock Products													
All cattle and calves	(No.)	4.8	....	....	13.5	....	17.0	14.3	17.5	7.5	5.2	9.4	....
Milk cows	(No.)	7.9	7.1	....	7.3	....	8.0	14.6	6.9	6.7	....	31.7	....
Hogs and pigs	(No.)	6.2	....	5.1	10.9	....	25.5	27.0	6.9	4.8	....	4.6	....
Sheep and lambs	(No.)	..	....	....	10.6	25.5	14.6	6.3	27.8	4.9	....	4.8	....
Chickens	(No.)	9.0	....	5.3	10.7	5.0	10.8	15.1	9.4	7.3	4.8	19.9	....
Eggs sold	(Doz.)	11.1	....	5.8	14.8	6.9	8.4	6.0	7.2	5.6	....	28.3	....
Broilers sold	(No.)	29.4	19.0	5.1	16.2	....	7.2	....	....	....	....	19.2	....

Source: Compiled from 1959 Census of Agriculture, Preliminary data.

[a] Percentages less than 4.5 omitted.

*Some data not shown to avoid disclosure of individual operations.

2. **North Central Louisiana Cutover Pine Area**—*Timber*, peaches, eggs, chickens, broilers, hogs and pigs, pecans, cotton.

3. **Red River Cotton Area**—*Cotton, pecans, hay, cattle and calves,* broilers, oats, eggs, hogs and pigs, chickens, sheep and lambs, corn.

4. **Cutover Flatwoods Area**—*Sheep and lambs, cattle and calves,* stumpage, eggs, chickens.

5. **Mississippi Delta Area**—*Cotton, soybeans, cattle and calves, oats, corn,* hogs and pigs, pecans, peaches, hay, sheep and lambs, chickens.

6. **Central Louisiana Mixed Farming Area**—*Cotton, sweet potatoes, corn, hogs and pigs,* Irish potatoes, sugar cane for syrup, chickens, hay, milk cows, cattle and calves, rice, soybeans, sugar cane for sugar, greenhouse and nursery.

7. **Louisiana Rice Area**—*Rice, cattle and calves,* sheep and lambs, sugar cane, hay, sweet potatoes.

8. **Louisiana Sugar Cane Area**—*Sugar cane for syrup, sugar cane for sugar, Irish potatoes, commercial vegetables,* corn, hay, cattle and calves.

9. **Southeast Mixed Farming Area**—*Cattle and calves,* commercial vegetables, Irish potatoes, sweet potatoes, oats, pecans, greenhouse and nursery.

10. **Louisiana Dairy, Poultry and Truck Area**—*Milk cows, strawberries, tung nuts, eggs, chickens, broilers, greenhouse and nursery, timber,* commercial vegetables, cattle and calves.

11. **New Orleans Truck and Fruit Area**—*Oranges, greenhouse and nursery,* commercial vegetables.

Louisiana's Crops: Trends in Acreage, Yield, Production, and Location of Production

Field Crops

Cotton

Cotton has traditionally been the major crop in Louisiana. However, acreage harvested generally declined from a high of 1,953,000 acres in 1930 to a low of 364,000 in 1958 (Figure 4, Page 23). Offsetting part of the decrease in acreage has been an increase in yield per acre. Yield of cotton lint per acre rose from an average of 191 pounds for the period 1930-1934 to 446 pounds for the period 1956-1960 (Figure 13, Page 26).

Average cotton production for the period 1956-1960 (444,600 bales) was the lowest since the period 1920-1924 (374,000 bales). The production of 297,000 bales in 1958 was the lowest production

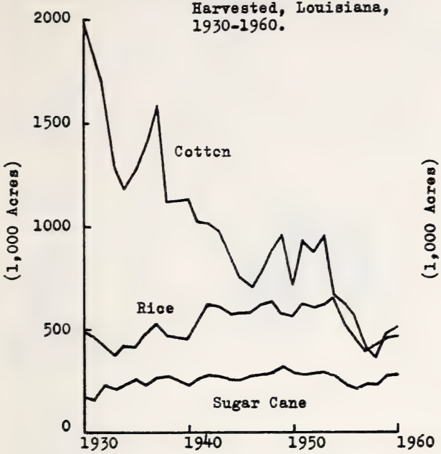


Figure 4. Cotton, Rice, and Sugar Cane: Acreage Harvested, Louisiana, 1930-1960.

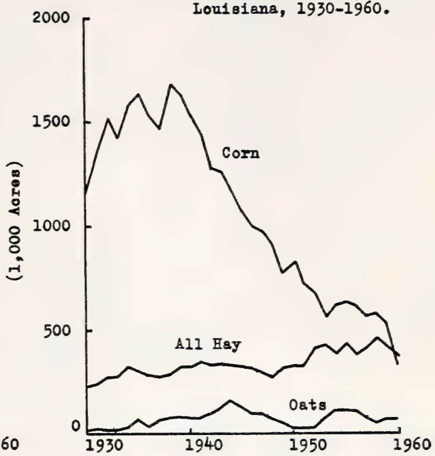


Figure 5. Corn, Oats, and Hay: Acreage Harvested, Louisiana, 1930-1960.

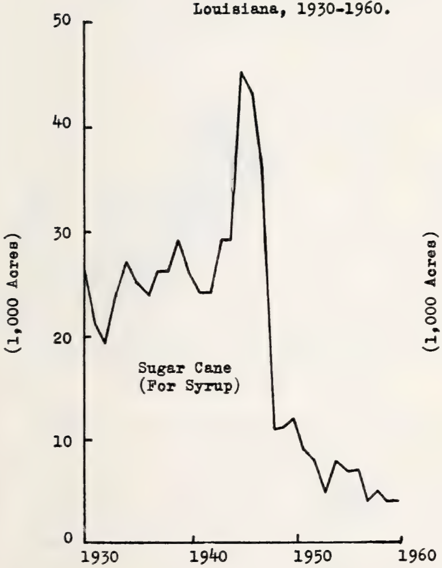


Figure 6. Sugar Cane (for syrup): Acreage Harvested, Louisiana, 1930-1960.

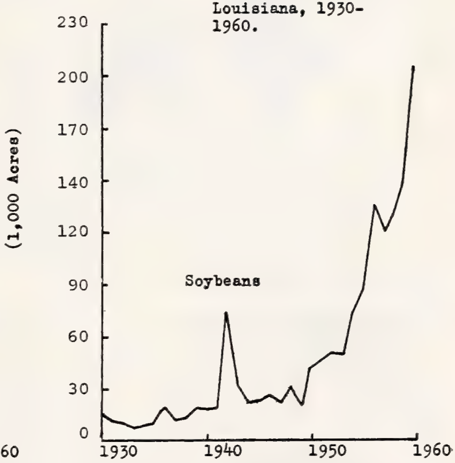


Figure 7. Soybean Acreage Harvested, Louisiana, 1930-1960.

since 1946 (Figure 21, Page 31). Increases in yield have been insufficient to offset the decline in acreage.

Noticeable shifts have occurred in the location of cotton production within the state. Cotton has shifted out of the upland and hill areas, although these areas continue to plant minor acreages. With the gradual disappearance of cotton in the upland and hill areas of the state (Areas 1A, 1B, 2, 4, 9, and 10) cotton production has become more and more concentrated in the alluvial deltas of the

Figure 8. Cotton (Acres)

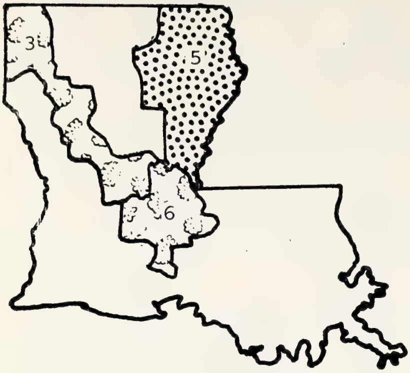


Figure 9. Rice (Acres)

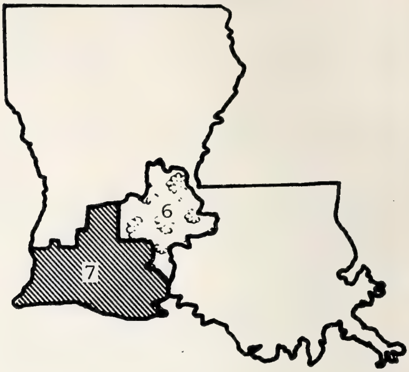


Figure 10. Corn (Acres)

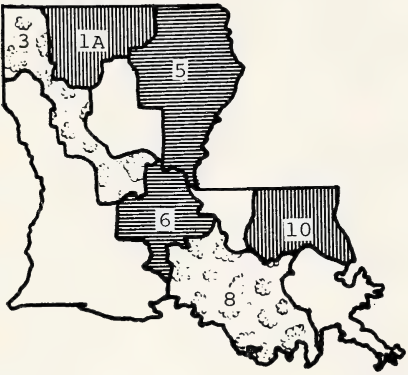
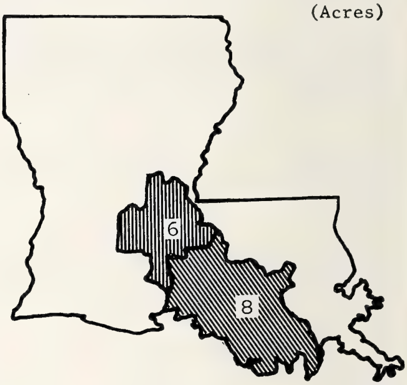
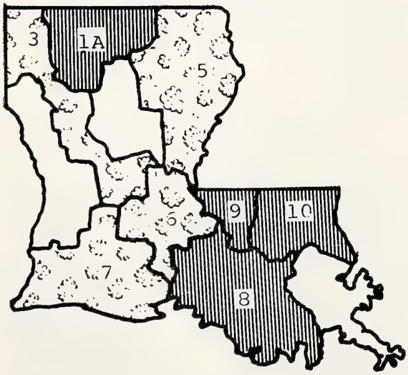


Figure 11. Sugar Cane for Sugar (Acres)



Concentration of Agricultural Production By Type of Farming Areas, Louisiana, 1959.
Per Cent of Total Acres

Figure 12. Hay (Acres)



□ 0 to 4.4 Per Cent

▥ 4.5 to 9.9 Per Cent

▒ 10 to 24.9 Per Cent

▤ 25 to 49.9 Per Cent

░ 50 to 74.9 Per Cent

▨ 75 to 100 Per Cent

(For more precise percentage figures for the above commodity maps (and all subsequent maps), please refer to Table 11, Page 21.)

Mississippi, Red, Ouachita, and Sabine Rivers (Figure 8, Page 24). In 1959, Areas 5, 3 and 6 accounted for approximately 90 per cent of the total acreage and more than 90 per cent of total production. The shift toward the delta areas is related to the higher yields obtainable on relatively more fertile soils that also were more readily adaptable to mechanization of production. Production remaining in the hill areas is concentrated on small bottomland acreages.

Rice

As compared with cotton, harvested rice acreage has been relatively stable during the past 45 years, although some year to year variation has occurred. For the five-year period 1956-1960, harvested acreage averaged 433,800 acres, compared with an average of 483,000 for the period 1915-1919. A recent peak was reached with 679,000 acres in 1954. Since 1955, acreage controls have had the effect of reducing acreage (Figure 4, Page 23).

Yields have generally increased since the 1930's (Figure 13, Page 26). These yield increases have undergone three distinct stages: (1) 1930-1953—a period of slow but deliberate yield increase, of from 15.8 hundredweight per acre in 1931 to 20.7 hundredweight per acre in 1953. Year to year increases in yield were small. (2) The years 1953 and 1954 produced sizable increments to yield, or from 20.7 hundredweight to 23.5 hundredweight per acre. From 1954 to 1955 the jump was even greater, from 23.5 to 28.0. (3) Yields following acreage control in 1955 have tended to level off. Yields per acre for the years 1956, 1957, 1958, and 1959 have been 27.0, 26.5, 26.5, and 28.5 hundredweight, respectively.

The trend in rice production has been upward, increasing from 7,214,000 hundredweight in 1931 to 12,699,000 hundredweight in 1953 and to a peak of 15,956,000 hundredweight in 1954. Since 1954, production has tapered to the volume of the early 1950's and was approximately 13,282,000 hundredweight in 1960 (Figure 22, Page 31).

Rice production has remained concentrated in the southwestern part of the state (Figure 9, Page 24). This is largely due to the influence of the soil type on location of rice production. Impervious subsoils are found generally in Area 7, and to a lesser extent in Area 6, particularly Evangeline Parish. Area 7 accounted for approximately 80 per cent and Area 6 another 14 per cent of the total rice acreage in 1959. The fringe areas (4 and 8) accounted for another 4 per cent of the total acreage.

Sugar Cane for Sugar and Seed

Sugar cane has a long economic history in Louisiana. For the period 1909-1913 acreage harvested for sugar and seed averaged 303,000 acres, subsequently decreasing to a low of 89,000 acres in 1927. The mosaic disease was largely responsible for the decline.

Figure 13. Cotton and Rice Yield Per Acre, Louisiana, 1930-1960.

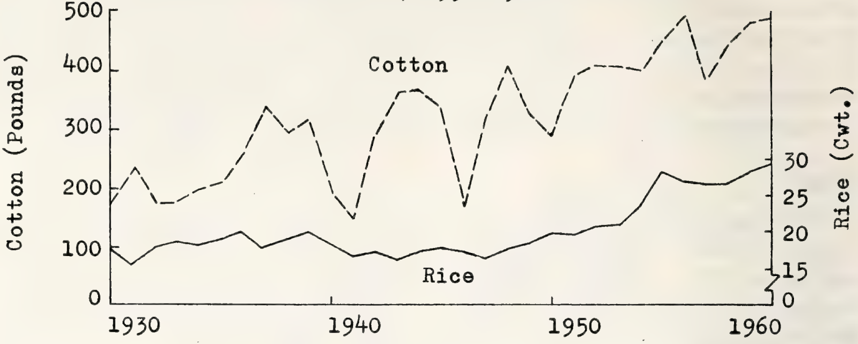


Figure 14. Sugar Cane and Corn Yield Per Acre, Louisiana, 1930-1960.

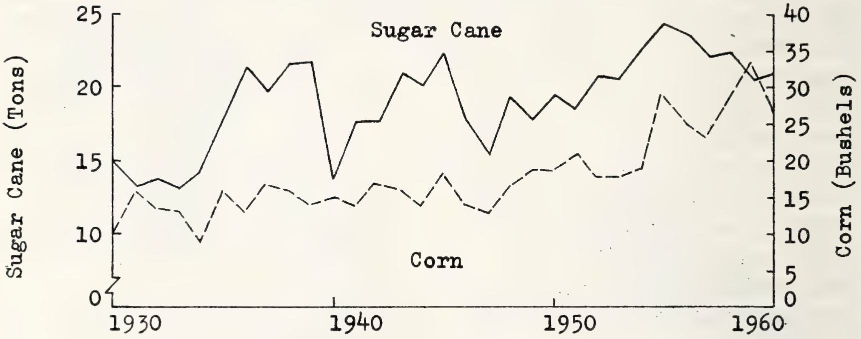
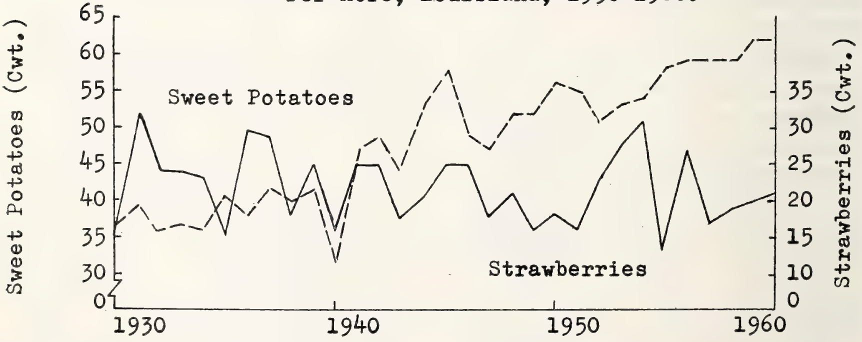


Figure 15. Sweet Potato and Strawberry Yield Per Acre, Louisiana, 1930-1960.



Resistant varieties were introduced and the spread of the disease effectively checked. After 1927, sugar cane acreage gradually increased so that by 1950-1954 it had just about reached the 1909-1913 level. Restrictive proportionate shares for the years 1955-1958 had the effect of again reducing the acreage, but in 1960 the acreage had increased to 279,000 acres (Figure 4, Page 23).

Average yield has increased rather slowly since the late 1930's. Yield per acre, expressed in tons, averaged 20.4 for the period 1935-1939, compared with an average of 22.0 for the period 1956-1960 (Figure 14, Page 26).

Production of sugar cane since 1942 has varied, with a few exceptions, between 5 and 6 million tons (Figure 22, Page 31). This represents a considerable recovery from a production of approximately 1 million tons in 1926, a year in which yield dropped to 6.8 tons per acre because of mosaic disease.

In 1959 the Sugar Cane Area (Area 8) accounted for approximately 90 per cent of the total acreage (Figure 11, Page 24). The only other area producing sugar cane of any significance is the Central Louisiana Mixed Farming Area with 7 per cent. Areas 3, 7, and 9 account for relatively minor acreages, and their relative importance has declined over time. Relative acreage devoted to sugar cane for sugar is also minor in Area 11 but rather constant over time.

Corn

Harvested corn acreage has decreased significantly since the late 1930's (Figure 5, Page 23). For the period 1935-1939 the average acreage harvested was 1,600,000 acres, compared with an average of 530,400 for 1956-1960.

Yields per acre, however, have gradually increased from an average of 15.5 bushels in 1935-1939 to an average of 27.5 bushels in 1956-1960. A new high of 33 bushels per acre was recorded in 1959 (Figure 14, Page 26). New hybrids have been largely responsible for these increases. Also, corn production has generally shifted into the more fertile areas.

Yield increases, however, have not been sufficient to offset the downward trend in acreage devoted to corn production. An average production of almost 25 million bushels per year was recorded for the period 1935-1939, while the average production of corn for the period 1956-1960 was less than 16 million bushels. The average production for the period 1956-1960, however, was an increase over average corn production of approximately 13.7 million bushels for the previous five-year period, 1951-1955 (Figure 21, Page 31).

Corn is grown in practically every parish in Louisiana. Some shifts, however, have occurred in the location of corn production over time. Increasing in relative importance have been the Mississippi Delta Area (5) and the Central Louisiana Mixed Farming

Area (6). Relative decreases in importance have occurred for Areas 1A, 1B, 2, 4, 7, and 11. Areas maintaining approximately their relative position in total acreage have been Areas 3, 8, and 10. In 1959, Areas 5 and 6 accounted for 54 per cent of the total acreage, with Areas 3, 8, and 10 accounting for an additional 30 per cent (Figure 10, Page 24).

Figure 16. Oats (Acres)

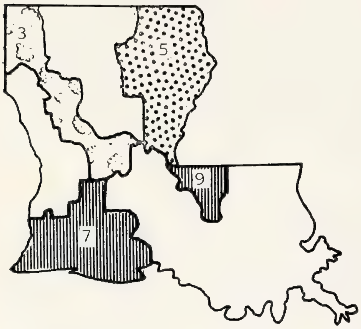


Figure 17. Sugar Cane for Syrup (Acres)

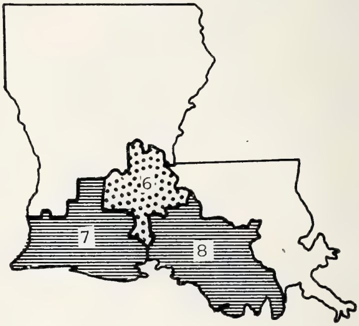


Figure 18. Soybeans (Acres)

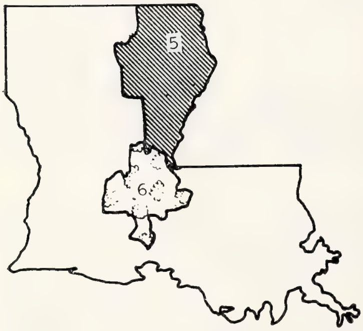


Figure 19. Sweet Potatoes (Acres)

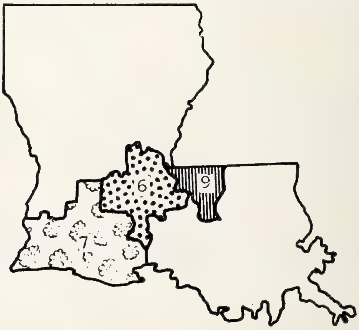
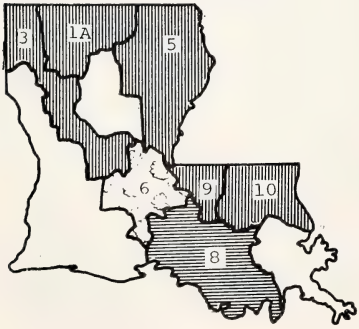


Figure 20. Irish Potatoes (Acres)



Concentration of Agricultural Production By Type of Farming Areas, Louisiana, 1959. Per Cent of Total Acres

□	0 to 4.4 Per Cent
▥	4.5 to 9.9 Per Cent
◌	10 to 24.9 Per Cent
▤	25 to 49.9 Per Cent
⁙	50 to 74.9 Per Cent
▨	75 to 100 Per Cent

Oats

Oat acreage in Louisiana shows a rather unstable pattern. No discernible trend is evident, although acreage harvested increased generally from 14,000 acres in 1939 to a peak of 152,000 in 1944, followed by a general decrease to 43,000 acres in 1951 (Figure 5, Page 23). After 1951, oats harvested for grain increased sharply to 124,000 acres in 1955, then decreased rather sharply to 40,000 acres in 1960. Increases or decreases of 30,000 acres from one year to the next have not been uncommon.

Oat yields have shown practically no improvement since the late 1930's. Average yields for successive five-year periods, 1935-1939, 1940-1944, 1945-1949, 1949-1954, 1955-1959, have been 28.5, 29.6, 26.3, 28.6, and 29.6 bushels per acre, respectively. A record oat yield of 35 bushels per acre, however, was recorded in 1960.

Because of the rather stable yield over time, production has followed the pattern established by acreage harvested. Production has varied considerably, or from less than 1 million bushels in 1950 to over 4 million bushels in 1955.

Oat production is concentrated in the Mississippi Delta (Figure 16, Page 28). This region accounted for approximately 80 per cent of total acreage in 1935, but had dropped to 60 per cent of the total by 1959. Most of this decline has been offset by relative increases in Areas 3, 7, and 9. All other areas have been relatively minor production areas. Hence, Areas 5, 3, 7, and 9 accounted for approximately 91 per cent of the total Louisiana acreage harvested in 1959.

Soybeans for Beans

Acreage devoted to soybeans has increased dramatically since the 1930's, particularly since 1954 (Figure 7, Page 23). For the period 1930-1934, an average of 10,600 acres was harvested, compared with an average of 149,600 acres for the period 1956-1960.

Average yields have almost doubled since 1930-1934. The average yield of 11.1 bushels per acre for the period 1930-1934 increased to an average of 21.6 bushels for the period 1956-1960.

With increases in both acreage harvested and average yields, it is not surprising that soybean production has also increased spectacularly. Production averaged 116,400 bushels for the period 1930-1934, compared with an average production of 3,278,000 bushels for the period 1956-1960.

Slightly over half of the state's soybean acreage was concentrated in the Mississippi Delta parishes of Concordia, East Carroll, Madison, and Tensas in 1959. The Mississippi Delta (Area 5) accounted for 85 per cent of Louisiana's soybean acreage. The only other significant soybean area in the state is the Central Louisiana Mixed Farming Area, which accounted for approximately 10 per cent of the acreage in 1959 (Figure 18, Page 28).

Hay

Harvested hay acreage in Louisiana has increased gradually from an average of 265,000 acres for the period 1930-1934 to an average of 411,600 acres for the period 1956-1960 (Figure 5, Page 23).

Considerable year to year variations in yield have occurred, although the general trend has been upward, or from an average of 1.16 tons of hay per acre for 1930-1934 to an average of 1.33 tons per acre for 1956-1960.

With general increases in both acreage harvested and yield per acre, total production of hay has increased from an average of 305,000 tons for the period 1930-1934 to an average of 549,200 tons for the period 1956-1960.

Hay is harvested in all areas of Louisiana, although Areas 5, 6, and 7 combined accounted for 84 per cent of the acreage harvested in 1959 (Figure 12, Page 24). The largest relative shift out of hay acreage was in the Sugar Cane Area. This area accounted for over one-fourth of the Louisiana hay acreage in 1934, but by 1959 its relative importance had dwindled to approximately 8 per cent of the total acreage. The Red River Cotton Area has shown the largest relative gain in hay acreage. In 1959 this area accounted for 19.1 per cent of the state total.

Sugar Cane for Syrup

Sugar cane for syrup acreage harvested has decreased considerably during the past 30 years (Figure 6, Page 23). Annual average acreage for the period 1930-1934 was 23,400 acres, compared with an average of only 4,800 acres for the period 1956-1960. The only major exception to this trend was the immediate post-war period, 1945-1947, when an average of 41,300 acres was harvested.

Syrup yields have increased during the 30 years, or from an average of 221 gallons per acre during 1930-1934 to a five-year high of 456 gallons per acre for the period 1956-1960.

Except for 1945-1947, total production of sugar cane syrup has generally decreased. For the period 1930-1934, production averaged above 5 million gallons of syrup per year. Production for the five-year period 1956-1960 averaged 2.1 million gallons.

In the past, sugar cane for syrup was produced generally throughout the state. During the most recent 30 years, however, production has largely shifted out of all areas except Areas 6, 7, and 8. Over time the Sugar Cane Area has increased its relative share of the total syrup acreage. In 1939 the Sugar Cane Area accounted for less than 20 per cent of the total acreage, but by 1959 it accounted for approximately 45 per cent of the total. In 1959, Areas 6, 7, and 8 accounted for approximately 87 per cent of the total acreage (Figure 17, Page 28).

Figure 21. Cotton and Corn Production, Louisiana, 1930-1960.

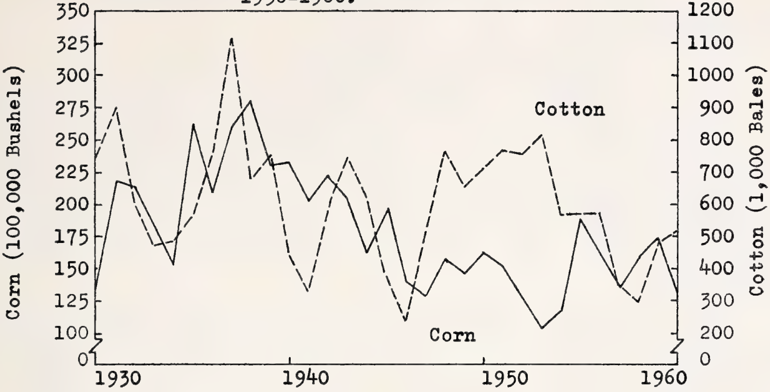


Figure 22. Rice and Sugar Cane Production, Louisiana, 1930-1960.

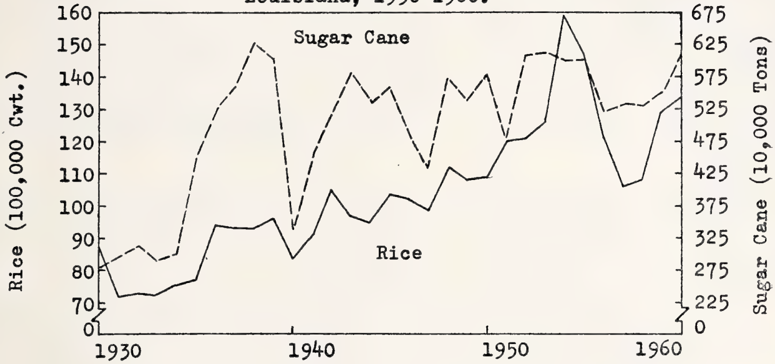
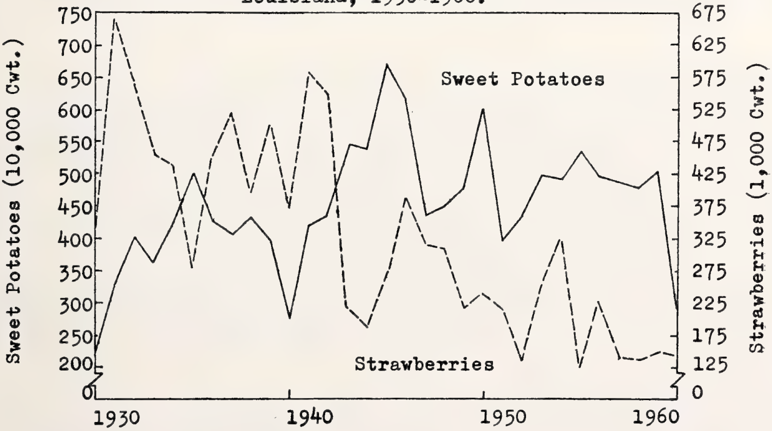


Figure 23. Sweet Potato and Strawberry Production, Louisiana, 1930-1960.



Vegetable Crops

Sweet Potatoes

Louisiana's sweet potato acreage has fluctuated widely from year to year (Figure 24, Page 33). The acreage trend is not readily discernible during the past 30 years because of large year to year changes. A year to year change of 20,000 acres is not an uncommon phenomenon. During the recent five-year period 1956-1960 acreage harvested averaged 75,600 acres, compared with an average of 95,800 for the period 1930-1934. A peak of 125,000 acres was established in 1946.

Yields have increased steadily during the past 30 years, or from an average of 37.4 hundredweight per acre in 1930-1934 to a high of 60.2 hundredweight for the period 1956-1960 (Figure 15, Page 26).

Total sweet potato production generally increased between 1930 and 1959, or from an average of approximately 3.5 million hundredweight in 1930-1934 to approximately 5 million hundredweight for the period 1955-1959. Peak production occurred in 1945 with approximately 6.7 million hundredweight. Except for 1945 and 1946, production of sweet potatoes has been below 6 million hundredweight, and in 1960 was only 3.1 million hundredweight (Figure 23, Page 31).

Sweet potato production has tended to localize in the Central Louisiana Mixed Farming Area (Area 6). This area accounted for approximately 70 per cent of Louisiana's sweet potato harvested acreage in 1959 (Figure 19, Page 28).

Areas 1A, 2, 3, 8, and 10 once devoted considerable acreage to sweet potato production. But in 1959 these areas combined accounted for less than 8 per cent of the total acreage harvested. Areas 6, 7, and 9 accounted for over 86 per cent of Louisiana's sweet potato acreage in 1959.

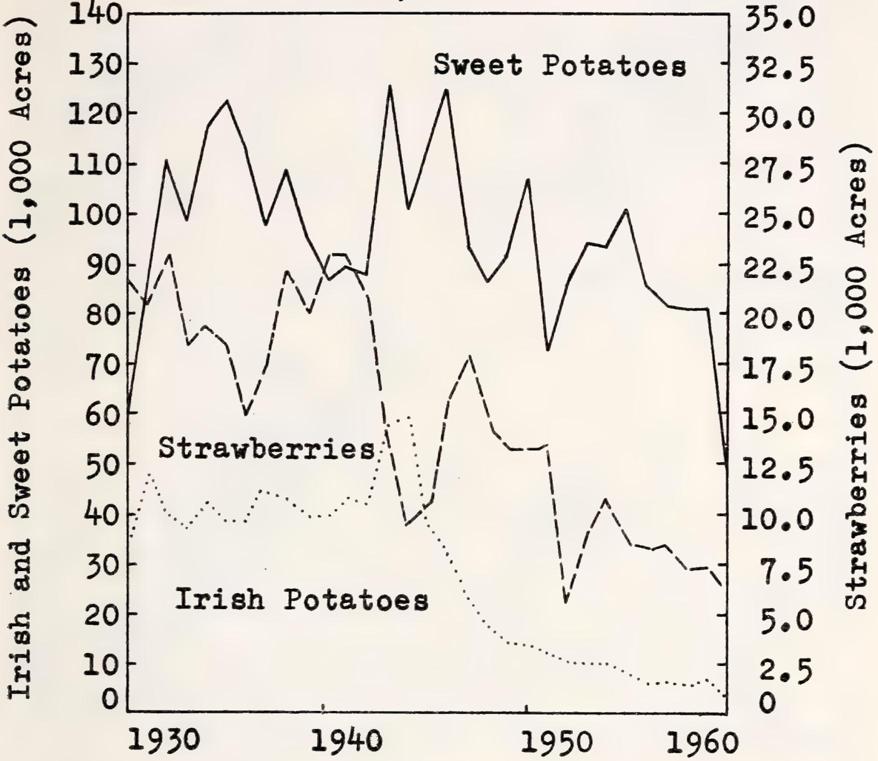
Irish Potatoes

Acreage devoted to Irish potatoes has decreased markedly during the past 30 years (Figure 24, Page 33). From an annual average of 40,400 acres harvested for the period 1930-1934, Irish potato acreage has been reduced to an average of 7,000 acres for the period 1956-1960. A peak of 59,000 acres was established in 1944 under a government-subsidized potato program.

Yield per acre has increased somewhat, or from 36 hundredweight per acre for the period 1930-1934 to 49.8 hundredweight for the period 1956-1960. A peak yield of 53 hundredweight per acre was established in 1960.

Production has generally declined throughout the 30-year period, except for increases in the early 1940's, particularly 1943 and 1944. Average annual production of Irish potatoes was 1.47 million

Figure 24. Sweet Potato, Irish Potato, and Strawberry Acreage Harvested, Louisiana, 1930-1960.



hundredweight in 1930-1934, compared to an average production of approximately 0.35 million hundredweight for 1956-1960.

The Sugar Cane Area and the Central Mixed Farming Area have traditionally supplied the bulk of Louisiana's Irish potato acreage. For 1959 the Sugar Cane Area accounted for 41 per cent of Louisiana's Irish potato acreage, while the Central Mixed Farming Area accounted for 18 per cent (Figure 20, Page 28). Areas 9, 5, 10, 1A, and 3 were relatively less important areas, having a combined total of 32 per cent of the total acreage.

Strawberries

With a few exceptions, there has been a gradual reduction in the total acreage of strawberries harvested since 1930 (Figure 24, Page 33). An average of only 7,720 acres was harvested for the

Figure 25. Commercial Vegetables (Acres)

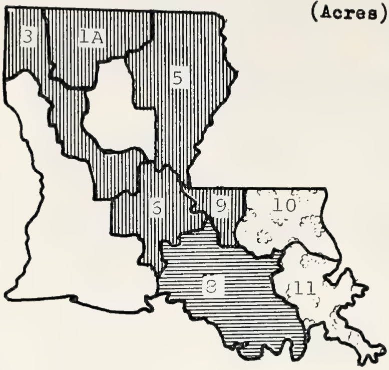


Figure 26. Nursery and Greenhouse (Dollar Sales)

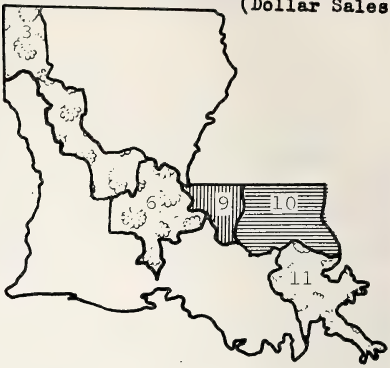


Figure 27. Strawberries (Acres)

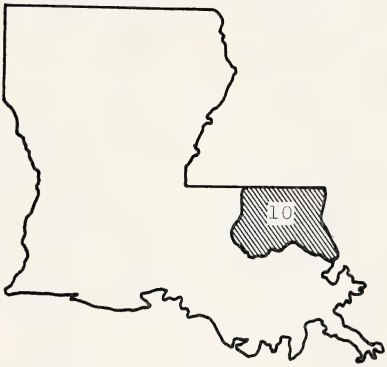


Figure 28. Pecans (Trees)

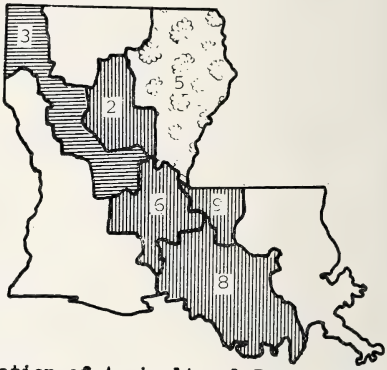
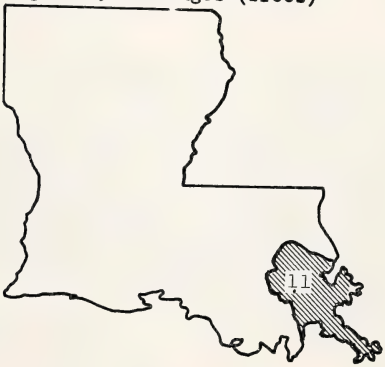


Figure 29. Oranges (Trees)



Concentration of Agricultural Production By Type of Farming Areas, Louisiana, 1959. Per Cent of Total Acres, Trees, or Dollars Sales

☐	0 to 4.4 Per Cent
▥	4.5 to 9.9 Per Cent
⁂	10 to 24.9 Per Cent
▤	25 to 49.9 Per Cent
⠿	50 to 74.9 Per Cent
▨	75 to 100 Per Cent

period 1956-1960, compared with an average of 20,740 for the period 1930-1934. There is, however, considerable year to year variation in acreage harvested. These year to year variations were most pronounced between the years 1943 and 1944, 1945 and 1946, and 1951 and 1952.

The influence of climate has considerable impact upon strawberry yields. The data show that yields have been irregular since 1930. The average yield for 1956-1960 was only 20.8 hundredweight per acre, somewhat less than for the previous five-year period and less than the 24.0 average for the period 1930-1934 (Figure 15, Page 26).

Total production of strawberries has generally decreased since 1930. An average of 495,000 hundredweight per year was produced during 1930-1934, while an average of 161,300 hundredweight was produced in the most recent period, 1956-1960 (Figure 23, Page 31).

There have been no major locational shifts, since Area 10 has traditionally been the dominant area of strawberry production (Figure 27, Page 34). This area accounted for 96 per cent of Louisiana's strawberry acreage in 1950 and for 98 per cent in 1959.

Commercial Vegetables

Commercial vegetables are defined as those vegetables grown for market. They include such commodities as watermelons, tomatoes, cabbage, snap beans, onions, shallots, garlic, green peppers, carrots, cucumbers, spinach, eggplant, and beets. Since, individually, none of these commodities represent major agricultural products in Louisiana, they are combined into one grouping for purposes of discussion. No attempt will be made to show acreage, yield, and production trends for each commodity in this grouping.

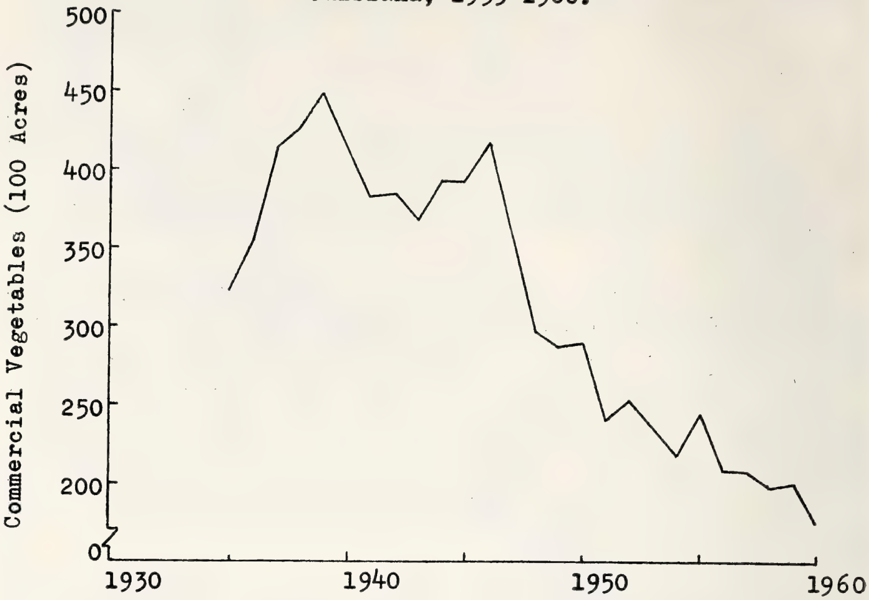
There has been a trend toward fewer harvested acres of commercial vegetables since 1944, when approximately 45,000 acres were harvested (Figure 30, Page 36). The average annual acreage devoted to commercial vegetables was 21,190 acres for the period 1955-1959. Commercial vegetables acreage in 1960 decreased to 17,500 acres.

Yields for practically all commodities classified as commercial vegetables have shown no discernible increase. Since climate is a major factor influencing yield for a particular year, there is considerable year to year variation in yields.

Because of a general decrease in acreage harvested and no significant increase in yield, total production for the various commercial vegetables has generally declined. For example, the total production of market tomatoes, snap beans (mid-spring and fall), shallots (spring and fall), and watermelons has generally decreased over the past 25 years, although for particular commodities and years the general trend may not have been applicable.

The major production areas for commercial vegetables have been

Figure 30. Commercial Vegetables Harvested Acreage, Louisiana, 1935-1960.



Areas 8, 10, and 11 (Figure 25, Page 34). These areas in 1959 accounted for approximately 57 per cent of the total acreage. However, no one area has been dominant throughout the past 30 years. Areas 1A, 3, 8, and 10, particularly, have varied in relative importance over time. The New Orleans Truck and Fruit Area (Area 11) has held a rather firm position over time and ranks second in importance to Area 8. Because of their perishable nature and high transportation costs, commercial vegetable production has tended to be located close to major metropolitan areas such as New Orleans, Baton Rouge, and Shreveport.

Nursery and Greenhouse Products

Over $4 million of nursery and greenhouse crops were sold in 1959 (Table 12). Lack of adequate data, however, prevents a thorough discussion of trends in acreage, yield, and production of nursery and greenhouse crops. Although most parishes report some sales of these crops, the major segment of the industry is located in the southern part of the state, particularly Areas 10 and 11 (Figure 26, Page 34).

Areas 10 and 11 accounted for approximately 53 per cent of the total sales in 1959. The only other significant areas were Areas 3 (particularly Rapides Parish), 6 (particularly Lafayette Parish), and 9 (particularly East Baton Rouge Parish). Areas 3, 6, and 9 accounted for approximately 32 per cent of the sales in 1959.

TABLE 12.—Sales of Nursery and Greenhouse Products, by Type of Farming Areas, Louisiana, 1959

Farming area	Total sales ($1,000)	Per cent of state total
1A	32.490*	0.8
1B	*	*
2	.445	*
3	476.377	11.5
4	35.368	.9
5	140.125*	3.4
6	520.220	12.5
7	115.193*	2.8
8	57.323*	1.4
9	349.445*	8.4
10	1,147.601*	27.6
11	1,035.426*	24.9
Total, Louisiana	4,159.179	94.2

Source: Compiled from 1959 Census of Agriculture, preliminary data.
*Some data not reported by the Census of Agriculture to avoid disclosure of individual operations.

In 1956 it was estimated that there were 740,153 square feet of greenhouse space in the state and 3,094 acres of field-planted stock.[7] The greenhouse space was heavily concentrated in the New Orleans Area, while aproximately two-thirds of the acreage was located in Area 10. Data are unavailable to indicate any change since 1956.

Fruits and Tree Nuts

Pecans (All Varieties)

The production of pecans has generally increased since 1930. For the period 1930-1934 an annual average of 7.4 million pounds was produced, compared with an average of 15.9 million pounds for the period 1956-1960. A peak of 25 million pounds was reached in 1955 (Figure 33, Page 38). Production of wild or seedling varieties has been approximately three times the production of improved varieties, although there is considerable variation from year to year in the proportion of the two types.

Pecans are grown in practically every area of the state. However, the Red River Area has traditionally been the most important. In 1959 this area accounted for approximately 41 per cent of all pecan trees. Area 5 has greatly increased its relative share of the total number of pecan trees in the state since 1939, while relative declines have been recorded by Areas 6 and 7. Areas 3 and 5 accounted for over 60 per cent of the state's pecan trees in 1959 (Figure 28, Page 34).

---

[7] A. C. Harper, R. H. Hanchey, and M. D. Woodin, **Production of Nursery and Greenhouse Crops in Louisiana**, Louisiana Agricultural Experiment Station, Bul. No. 511, June 1957, p. 5.

Figure 31. Orange Production, Louisiana, 1930-1960.

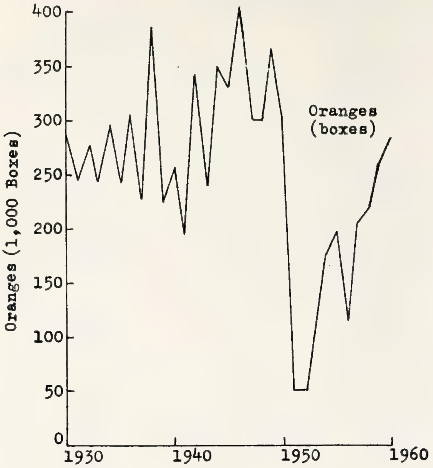


Figure 32. Peach Production, Louisiana, 1930-1960.

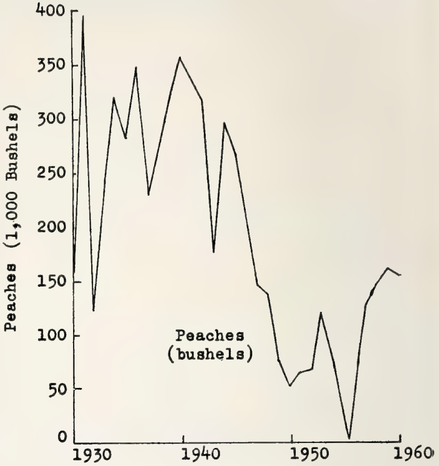


Figure 33. Pecan Production, Louisiana, 1930-1960.

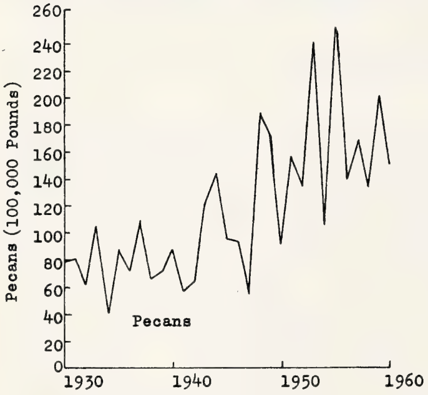
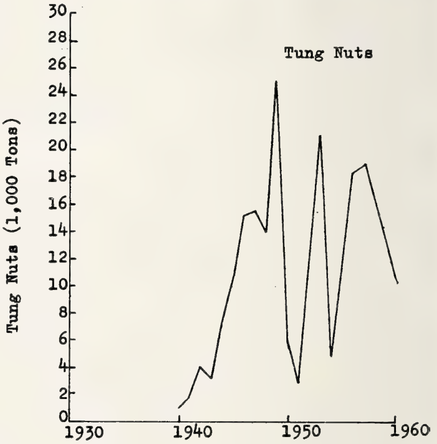


Figure 34. Tung Nut Production, Louisiana, 1930-1960.



Peaches

Peach production has generally declined since the 1930's (Figure 32, Page 38). The average production for the period 1930-1934 was 246,000 bushels. Production generally increased until 1940, when peach production was 358,000 bushels. After 1940, production decreased to less than 500 bushels in 1955, when a peach crop failure was recorded in Louisiana. Production gradually increased after 1955 to 150,000 bushels in 1959.

Peach production has become more and more localized in the northern part of the state, particularly Areas 1A, 2, and 5. These three areas in 1959 accounted for 90 per cent of the total number of trees in the state (Figure 36, Page 39). All other areas of the state have gradually reduced their production until, by 1959, they were of relatively little importance.

Oranges

Louisiana's production of oranges has undergone three distinct phases: (1) A general increase in production over time to a peak of 410,000 boxes in 1946. (2) A rapid fall to 50,000 boxes for both 1951 and 1952, because of damaging frosts. (3) A gradual increase in production since 1952, i.e., 275,000 boxes in 1960 (Figure 31, Page 38).

Climatic factors restrict the location of commercial orange production to the Coastal area of Louisiana. The New Orleans Area (11) has been the dominant production region throughout Louisiana's orange history (Figure 29, Page 34). Orange production is principally confined to Plaquemines Parish, since this parish is relatively frost free. In 1954, Area 11 accounted for 97 per cent of the total number of trees, and in 1959 for 92 per cent of the total. The small relative drop in Area 11's position is due to minor relative increases in Areas 7 and 8.

Figure 35. Tung Nuts (Trees)

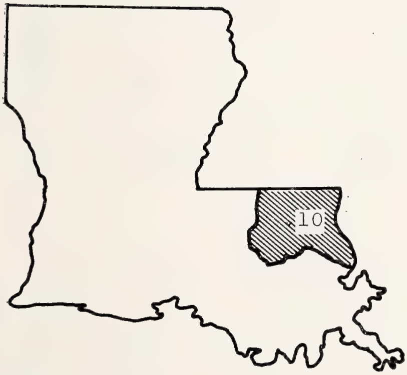
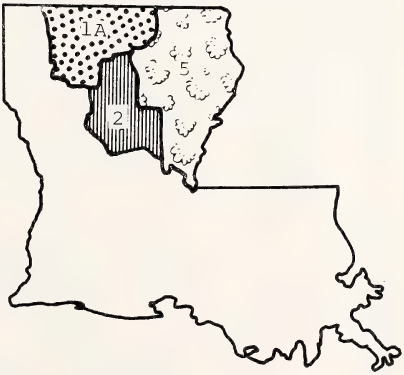


Figure 36. Peaches (Trees)



Concentration of Agricultural Production By
Type of Farming Areas, Louisiana, 1959.
Per Cent of Total Trees

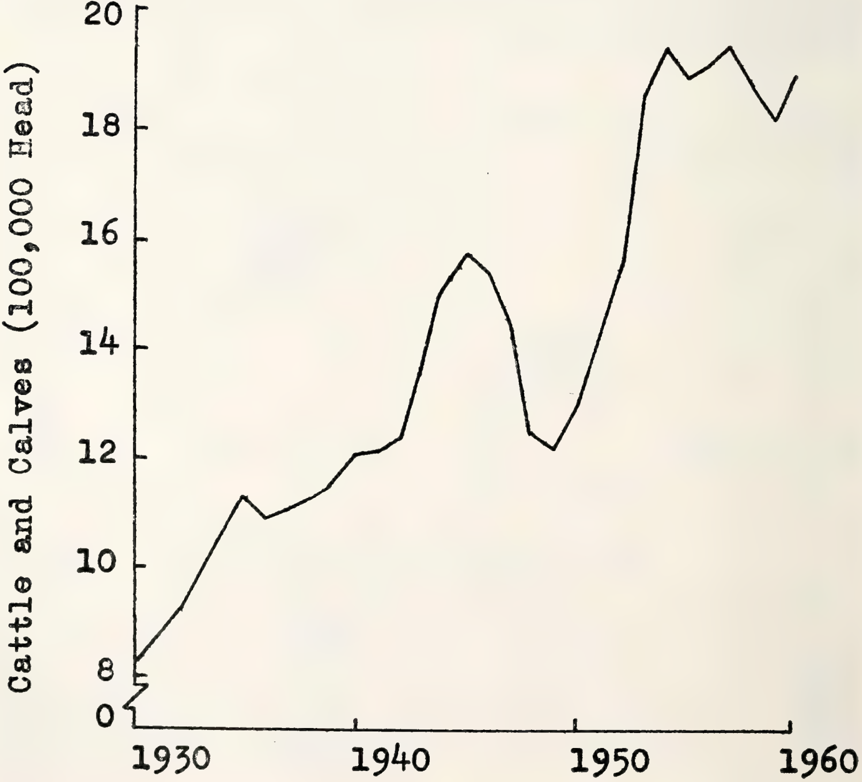
□	0 to 4.4 Per Cent	▤	25 to 49.9 Per Cent
▥	4.5 to 9.9 Per Cent	░	50 to 74.9 Per Cent
▢	10 to 24.9 Per Cent	▧	75 to 100 Per Cent

Tung Nuts

Louisiana's tung industry is relatively young. Only since 1939 has Louisiana produced a significant volume of tung nuts. The expansion of the industry was rapid during the period 1939-1949, stimulated by military need for tung oil during World War II (Figure 34, Page 38). Production of tung nuts increased from 150 tons in 1939 to 25,200 tons in 1949. After two poor years in 1950 and 1951, production reached a peak in 1952 of 30,200 tons. A freeze in 1955 reduced the production to negligible quantities. Production averaged approximately 16,900 tons per year for the period 1956-1960.

Area 10 has been the only area of significance throughout the tung industry's recent economic history, accounting for 95 per cent of the state's tung nut trees in 1939 and for 99 per cent in 1959 (Figure 35, Page 39). Within Area 10, tung production is concentrated in St. Tammany, Washington, and Tangipahoa parishes.

Figure 37. Number of Cattle and Calves, Louisiana, 1930-1960.



Louisiana's Livestock: Trends in Numbers, Production, and Location of Production

All Cattle and Calves

There has been a considerable increase in the number of cattle and calves during the past 30 years in Louisiana (Figure 37, Page 40). Cattle numbers averaged 886,000 head for the period 1930-

Figure 38. Production of Cattle and Sheep, Louisiana, 1930-1960.

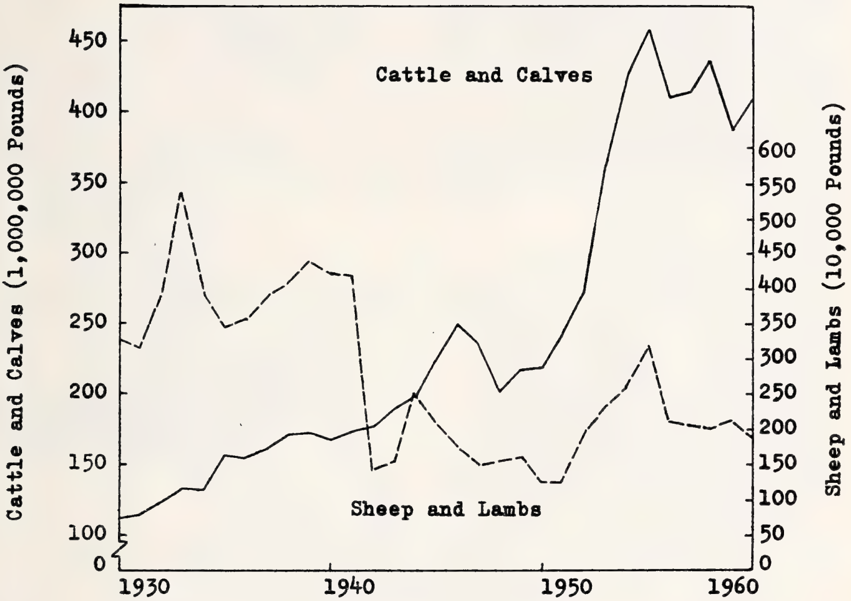
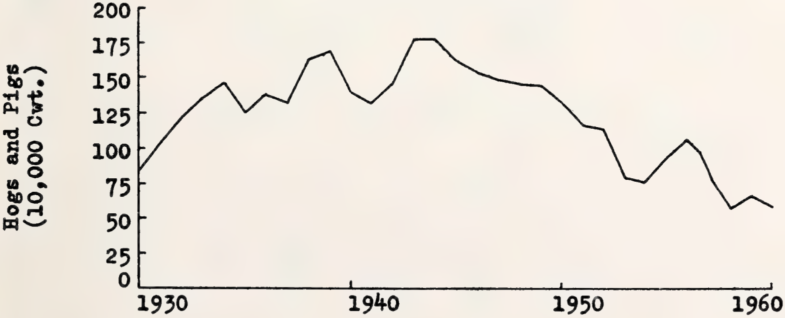


Figure 39. Production of Hogs and Pigs, Louisiana, 1930-1960.



1934, but by 1956-1960 the average had risen to 1,830,000 head. A peak of 1,942,600 was reached in 1957.

Along with the rise in numbers there has been a general increase in cattle production (Figure 38, Page 41). The average annual production for the period 1930-1934 was approximately 123 million pounds, which increased to an average of 413 million pounds for the period 1956-1960.

The Louisiana Rice Area (7) accounts for the largest relative share of Louisiana's cattle and calves, or 17.5 per cent in 1959. Other major areas in order of importance are the Mississippi Delta Area (5), the Central Mixed Farming Area (6), and the Red River Cotton Area (3) (Figure 40, Page 43).

Since 1939, the relative position of the Louisiana Rice Area has declined somewhat, while Areas 5 and 10 have improved their relative positions. Areas 3, 5, 6, 7, and 10 accounted for approximately three-fourths of the total number of cattle and calves in 1959. Sizable numbers of cattle are also located in the Sugar Cane Area and, to a lesser extent, in Areas 9, 1A, 1B, 2, and 4.

Milk and Milk Cows

The number of milk cows in Louisiana has generally increased since 1930, but the trend has been irregular (Figure 45, Page 44). The number of milk cows increased steadily from 224,000 in 1930 to 296,000 in 1944 and 1945 and then decreased to 258,000 in 1949. This was followed by a rapid period of expansion of Louisiana herds to a peak of 310,000 cows in 1954. Since 1954 the number of milk cows has decreased sharply. Only 232,000 milk cows were reported in 1960, the lowest number since 1930.

Both total production and milk per cow have increased rather steadily during the past 30 years (Figure 44, Page 44). Milk production per cow per year for the period 1930-1934 was 2,314 pounds, compared to an annual average of 3,198 pounds for the period 1956-1960. Increases have been particularly significant since 1954. A peak of 3,630 pounds per cow was reached in 1960. Commercial dairy herds, however, greatly exceed the state average. Average production per cow in commercial herds enrolled in the Agricultural Extension Service's Weigh-A-Day-A-Month plan exceeded 7,000 pounds in 1960. Total milk production increased from an average of 556 million pounds for the period 1930-1934 to an average of 831 million pounds for the period 1956-1960. A peak of 846 million pounds was achieved in 1957.

It is interesting to note that it was not until 1949 that total milk sold clearly exceeded total milk used on farms. The gap between milk sold and milk used on farms has continued to widen since 1949. Milk sold has increased sharply while milk used on farms has dropped steadily since 1945.

Area 10 has witnessed a dramatic rise in relative importance in

Figure 40. Cattle and Calves (Number)

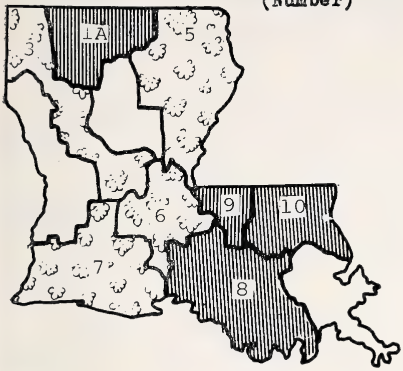


Figure 41. Milk Cows (Number)

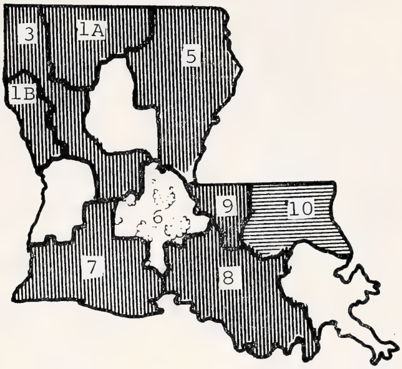


Figure 42. Hogs and Pigs (Number)

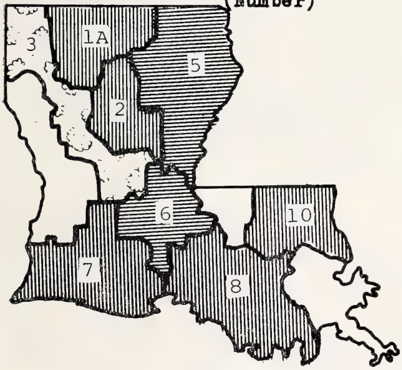
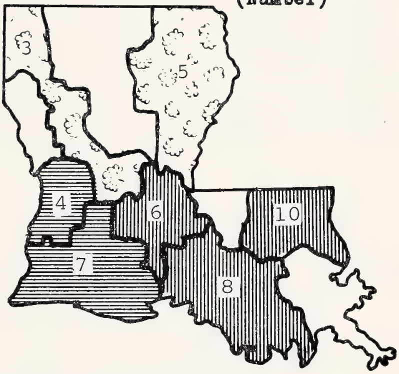


Figure 43. Sheep and Lambs (Number)



Concentration of Agricultural Production By Type of Farming Areas, Louisiana 1959. Per Cent of Total Number

□ 0 to 4.4 Per Cent

▥ 4.5 to 9.9 Per Cent

░ 10 to 24.9 Per Cent

▤ 25 to 49.9 Per Cent

⁘ 50 to 74.9 Per Cent

▧ 75 to 100 Per Cent

milk production. Area 10 accounted for approximately 9 per cent of Louisiana's milk cows in 1929, and by 1959 the area accounted for 32 per cent (Figure 41, Page 43). Because of the perishability and high transfer costs of milk, production tends to be located close to urban areas. The Central Mixed Farming Area is second in relative importance; it had approximately 15 per cent of the state's milk cows in 1959. Other areas of importance (approximately 7 per cent each) are 1A, 1B, 3, 5, 7, and 8. The New Orleans Area, once

Figure 44. Total Milk Produced and Milk Per Cow, Louisiana, 1930-1960.

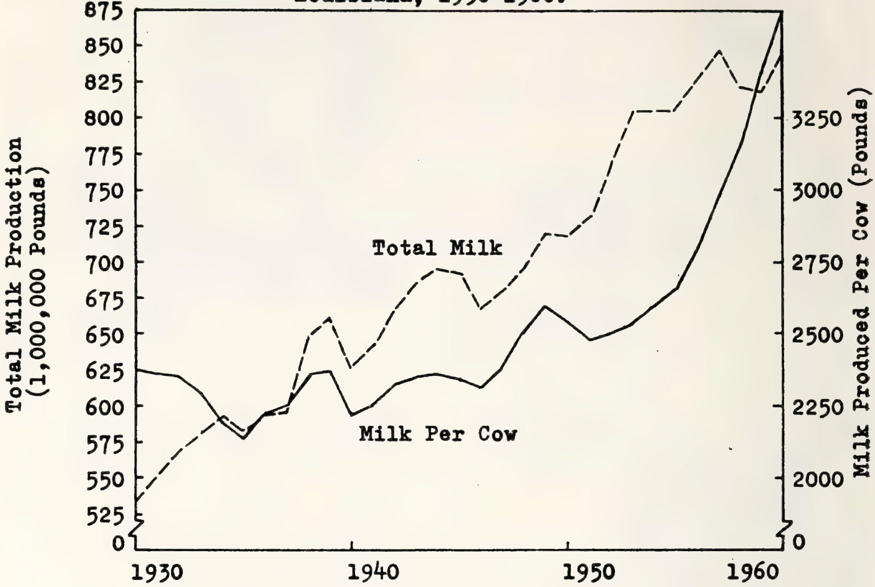
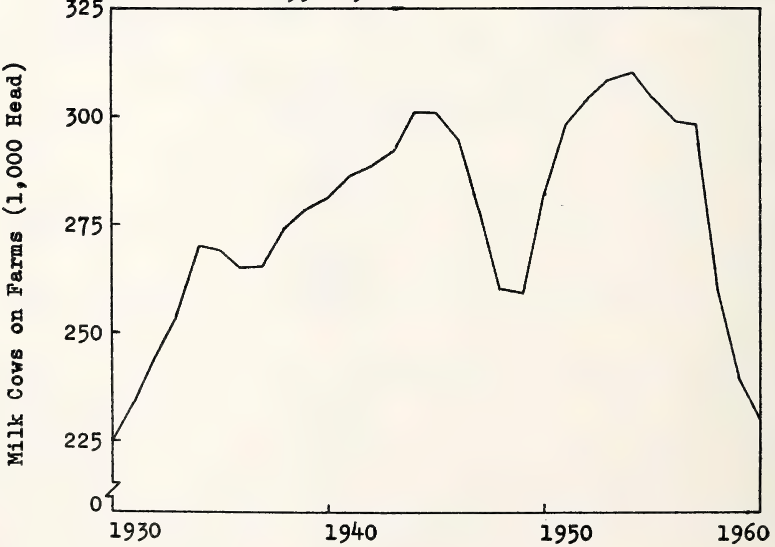


Figure 45. Number of Milk Cows, Louisiana, 1930-1960.



an important dairying region, has virtually shifted out of milk production.

All Hogs and Pigs

The total number of all hogs and pigs increased sporadically until 1944, when a peak of approximately 1 million head was reached. There has been a rather steady decline in numbers since 1944, with a low of 324,000 hogs recorded in 1959 (Figure 46, Page 45). Hog numbers averaged 396,000 for the five-year period 1956-1960.

Hog production generally increased from 823,000 hundredweight in 1930 to approximately 1.8 million hundredweight in 1943, but production dropped sharply to a low of 580,000 hundredweight in 1958 (Figure 39, Page 41).

The Central Mixed Farming Area is the major hog producing region of the state, accounting for approximately 27 per cent of all hogs in 1959 (Figure 42, Page 43). The second most important region is Area 5 with 26 per cent of the total. The only other major hog producing regions are Areas 3, 7, and 1A, in that order of importance, although hogs are produced in all areas of the state. Major shifts in production areas have not occurred, although Areas 2, 3, and 10 have decreased their relative importance slightly, while Area 5 has increased its relative position.

Sheep and Lambs

After a general rise in sheep and lamb numbers from 245,000 head in 1929 to a peak of 296,000 head in 1942, the trend has been

FIGURE 46.—Number of Hogs and Sheep, Louisiana, 1930-1960.

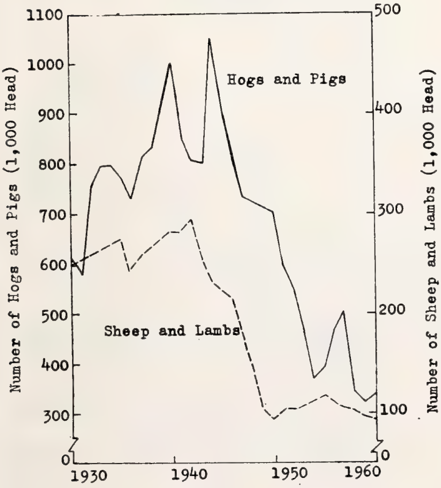
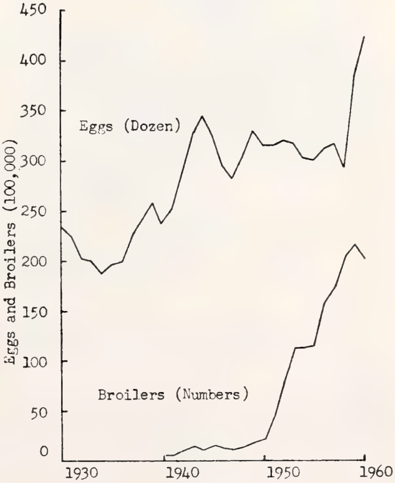


FIGURE 47.—Egg Production and Number of Broilers, Louisiana, 1930-1960.



sharply downward in numbers in Louisiana (Figure 46, Page 45). A new low of only 93,000 head was recorded for 1960.

Sheep and lamb production has also shown an irregular pattern (Figure 38, Page 41). A peak of 5.3 million pounds was reached in 1933, while the 30-year low recorded was 1.3 million pounds in 1950 and 1951. Production averaged 2.2 million pounds for the five-year period 1956-1960.

The southwest portion of the state (Areas 4 and 7) accounts for over half of the total number of sheep and lambs (Figure 43, Page 43). Area 4, once the dominant sheep region of the state, has slipped in relative importance, and in 1959 the Rice Area (7) accounted for the largest percentage of animal numbers. The Mississippi Delta Area (5) is rapidly enhancing its relative position in sheep. That area accounted for approximately 15 per cent of all sheep and lambs in 1959, compared with only 3 per cent in 1929. Approximately 80 per cent of Louisiana's sheep and lamb population in 1959 was located in Areas 3, 4, 5, and 7.

Eggs

Egg production has generally increased in Louisiana from an average annual production of 21 million dozen for the period 1930-1934 to 34.7 million dozen for the period 1956-1960 (Figure 47,

Figure 48. Eggs Sold (Dozen)

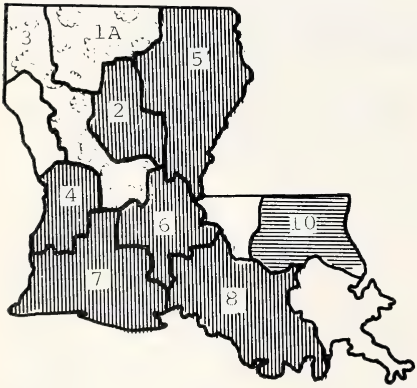
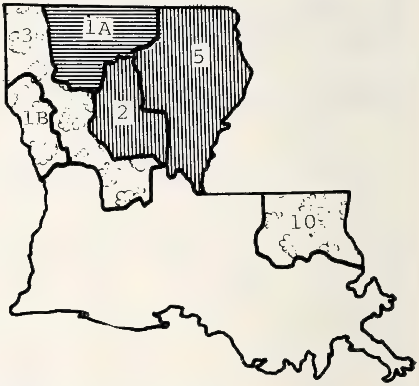


Figure 49. Broilers (Number)



Concentration of Agricultural Production By
Type of Farming Areas, Louisiana, 1959.
Per Cent of Total Dozen or Number

□ 0 to 4.4 Per Cent
▥ 4.5 to 9.9 Per Cent
⬚ 10 to 24.9 Per Cent
▤ 25 to 49.9 Per Cent
▦ 50 to 74.9 Per Cent
▧ 75 to 100 Per Cent

Page 45). Of the total, *eggs consumed on the farm* exceeded eggs sold for the period 1930-1938. Since 1939, egg sales have greatly exceeded farm egg consumption, with the gap widening over time. The general rise in egg production has been accomplished with a general decrease in the total number of hens, which indicates that production of eggs per bird has generally increased.

Area 10 has greatly increased its relative share of the state's egg production, accounting for approximately 10 per cent of the state's egg production in 1950 and 28 per cent of the total by 1959. Relative increases of lesser importance have occurred in Areas 1A, 2, and 4. The Red River Area was second to Area 10 in relative importance in 1959. Areas 1A, 2, 3, 4, and 10 accounted for approximately two-thirds of the total egg production in 1959 (Figure 48, Page 46).

Commercial Broilers

There has been a sharp and continuous rise in the production of broilers in Louisiana, particularly since 1950, in both numbers and pounds (Figure 47, Page 45). Production jumped from less than 1 million pounds per year for the period 1934-1939 to over 53 million pounds for the period 1955-1959. In 1959 production reached a peak of 69.3 million pounds.

The Upland Louisiana Timber Area is the major broiler area of the state, accounting for 32 per cent of the total in 1954 and 29 per cent in 1959. Other major areas are 1B, 3, and 10 (Figure 49, Page 46). Areas 1A, 1B, 3, and 10 accounted for 83 per cent of Louisiana's broiler production in 1959. Area 10 has shown the largest relative advance in position, particularly since 1954, accounting for only 3 per cent of the total in 1954 as compared with 19 per cent in 1959.

Louisiana's Forests

Louisiana has a great abundance and variety of trees, having some 150 species of trees and over 16 million acres classed as commercial forest land. In terms of forest types, hardwoods account for approximately 64 per cent of all forest land, while pine accounts for 31 per cent. The balance is represented by other softwoods. Acreage in softwoods was relatively higher in 1953-1954 compared with 1934-1935, while hardwood acreage was down 4 per cent.

Slightly over three-fourths of Louisiana's forest land is industrially owned. Farm ownership accounts for approximately 18 per cent of the total, while federal, state, parish, and municipal ownership accounts for 6 per cent.

The intensity of forest land varies somewhat within the state. Areas 7, 8, and 11 are the least forested, while Areas 1A, 1B, 2, 4, and 10 are densely forested (Table 13). Areas 1A, 1B, and 2 have

TABLE 13.—Land Area and Commercial Forests, by Type of Farming Areas, Louisiana, 1953-1954

Type of farming area	Total land area	Commercial forests		Area's per cent of total Louisiana forest acreage
			Per cent of total land area	
	1,000 Acres	1,000 acres		
1A	2,299.5	1,575.6	68.5	9.8
1B	1,230.2	916.4	74.5	5.7
2	1,818.2	1,608.5	88.5	10.0
3	3,053.2	2,052.1	67.2	12.8
4	1,628.2	2,394.6	85.7	8.7
5	4,309	2,748.1	63.8	17.1
6	2,096.0	1,020.4	48.7	6.4
7	3,754.9	825.4	22.0	5.2
8	4,110.0	1,547.0	37.6	9.7
9	848.7	515.0	60.7	3.2
10	2,215.0	1,670.6	75.4	10.4
11	1,540.0	164.3	10.7	1.0
State Total	28,903.7	16,038.0	55.5	100.0

Source: Compiled from U. S. Forest Service, **Forests of Louisiana 1953-1954**, (Southern Forest Experiment Station, New Orleans), Forest Survey Release 75, April 1955, p. 31.

increased forest acreage considerably since 1935 because of the reversion of abandoned farm land to forest land. Also significant in recent years has been the impact of the Federal Soil Bank program and tighter production acreage controls in the basic crops. These programs have had the effect of converting additional farm land into forest land.

In eight parishes of the state (Bienville, Grant, Jackson, LaSalle, Livingston, Sabine, Union, and Winn) income from timber harvest in 1959 exceeded the income from marketing farm products.[8] Hence all parishes in Area 2, plus one or more of the parishes in Areas 1A, 1B, and 10, are significant timber producers. In 1959 the stumpage value of harvested pulpwood and timber in these eight parishes totaled 24.4 million dollars, or more than double the total cash farm income from farm marketings in the area. The difference between forest and farm income was most pronounced for Winn Parish ($3.253 million, or approximately six times more forest income than farm income).

Production of sawtimber in Louisiana is about twice as much as the cut. Timber growth is approximately 716 million cubic feet annually, while the 1953 cut was 366 million cubic feet. Forest management practices have improved considerably in recent years, particularly where large acreage holdings predominate.

---

[8] Floyd L. Corty, "Cash Income From Farm Marketings Compared To Returns From Timber and Pulpwood," **Louisiana Rural Economist**, Vol. 22, No. 3, August 1960, pp. 14-15.

The Contribution of Agriculture to Louisiana's Manufacturing Industries

The combined total of all food processing, apparel, lumber, furniture, and pulp and paper industries in 1958 accounted for over half of Louisiana's manufacturing employees and over 40 per cent of the manufacturing payroll. This is dramatic evidence that despite huge gains in non-agricultural manufacturing, such as chemicals and petroleum in recent years, processing the products of agriculture and forestry still dominates the state's industrial complex.

Establishments, Employees, and Payroll

In 1958 there were 734 food product establishments in Louisiana, 315 of which had 20 or more employees per establishment (Table 14). These food establishments employed approximately 30,000 persons and had an annual payroll of $110 million dollars. On the basis of major industry groups, the food and kindred products manufacturing industry is the largest *manufacturing* industry in Louisiana—even larger than the chemical and petroleum industries—when measured in terms of size of payroll and number of employees (Table 15). The lumber and wood products industry employs 17,048 persons, only a few employees behind the chemical industry's 17,133. The pulp and paper industry ranks fourth in terms of number of employees, with 16,889. These data suggest the importance of Louisiana's forest industry. The combined lumber and wood products, furniture, and pulp and paper products industries account for almost 35,000 employees, who receive an annual payroll of over $134 million. Although the lumber and wood products industries employ approximately the same number of persons as the pulp and paper products industries, the annual payroll of the latter is approximately double the total payroll for persons employed in the lumber and wood products industries (Table 15). This reflects differences in wage rates, in the number of skilled employees, and in the seasonality of employment in the two industries.

Value Added

Value added is a measure of the net product contributed by the manufacturing sector of the economy. For 1958, manufacturing firms in Louisiana produced an added value, or net product, of over $1.4 billion. The food and kindred products industry ranked second, behind the chemical industry, in terms of value added in 1958 (Table 16). This can be partly explained by the fact that raw agricultural products undergo a lesser degree of change in the manufacturing process. For example, canned sweet potatoes differ from raw sweet potatoes mainly because of relatively simple operations—washing, peeling, slicing, cooking and sealing in metal cans. In com-

TABLE 14.—Louisiana Manufacturing Establishments, 1958

Major industry group	Establishments: Number	Establishments: Per cent of total	Having more than 20 employees: Number	Having more than 20 employees: Per cent of total
Food and kindred products	734	23.4	315	33.4
Apparel and related products	75	2.4	37	3.9
Lumber and wood products	772	24.7	165	17.5
Furniture and fixtures	87	2.8	22	2.3
Pulp, paper, and related products	45	1.4	38	4.1
Sub-total	1,713	54.7	577	61.2
Printing and publishing	351	11.2	48	5.1
Chemical and related products	191	6.1	85	9.0
Petroleum and coal products	39	1.2	25	2.7
Stone, clay, and glass products	194	6.2	56	5.9
Primary metal industries	26	.8	11	1.2
Fabricated metal products	170	5.4	40	4.2
Machinery, except electrical	200	6.4	38	4.0
Transportation equipment	108	3.4	34	3.6
Total All Industries[a]	3,133	95.4	942	96.9

Source: Compiled from 1958 Census of Manufacturers, Department of Commerce, Advance Information, March 1960.

[a] Some figures for industry groups have been withheld from publication in order to: (1) permit further checking of figures for smaller industry groups, and (2) avoid disclosing figures for individual companies.

parison, for some products of the chemical industry the basic raw materials undergo considerable transformation to achieve a final product. Petroleum is the third largest manufacturing industry in Louisiana in terms of value added. It is followed closely by the pulp, paper and related products industry (Table 16).

New Capital Expenditures

New capital expenditures are a crude measure of the growth of an industry, but they also may indicate whether an industry is labor intensive or capital intensive. The chemical and petroleum

TABLE 15.—Louisiana Manufacturing: Employees and Payroll, 1958

Major industry group	All employees		Payroll	
	Number	Per cent of total	($1,000)	Per cent of total
Food and kindred products	29,816	21.8	110,349	17.8
Apparel and related products	5,567	4.1	14,292	2.3
Lumber and wood products	17,048	12.4	44,291	7.1
Furniture and fixtures	1,406	1.0	4,474	0.7
Pulp, paper, and related products	16,889	12.3	85,293	13.7
Sub-total	70,726	51.6	258,699	41.6
Printing and publishing	5,314	3.9	23,452	3.8
Chemicals and related products	17,133	12.5	100,469	16.2
Petroleum and coal products	14,280	10.4	94,217	15.2
Stone, clay, and glass products	6,324	4.6	28,998	4.7
Primary metal industries	3,529	2.6	22,226	3.6
Fabricated metal products	5,806	4.2	29,758	4.8
Machinery, except electrical	3,319	2.4	15,610	2.5
Transportation equipment	6,835	5.0	33,564	5.4
Administrative and auxiliary[a]	572	0.4	3,373	0.5
Total All Industries[b]	137,124	97.6	621,742	98.3

Source: Compiled from 1958 U. S. Census of Manufacturers, Department of Commerce, Advance Information, March 1960.

[a] Employees in central administrative offices are concerned with the general management of multi-establishment companies, that is to say, with the general supervision and control of two or more units such as manufacturing plants, mines, sales branches, or stores. Auxiliaries are separate storage facilities, garages, repair shops, purchasing offices, sales promotion offices, development and research organizations, etc. serving the plants or central management of the company.

[b] Some figures for industry groups have been withheld from publication in order to (1) permit further checking of figures for smaller industry groups, and (2) avoid disclosing figures for individual companies.

industries lead all other industry groups, by a considerable margin, in terms of new capital expenditures. The food and pulp industries are ranked third and fourth, respectively. A plausible argument is that the chemical and petroleum industries of Louisiana are capital intensive. They account for approximately 70 per cent of new capital expenditures but only 23 per cent of total employment in manufacturing.

The food, lumber, and pulp industries are relatively labor in-

TABLE 16.—Louisiana Manufacturing: Value Added and New Capital Expenditures, 1958

Major industry sector	Value added, adjusted		New capital expenditures	
	$1,000	Per cent of total	$1,000	Per cent of total
Food and kindred products	269,067	18.7	15,209	9.2
Apparel and related products	22,275	1.5	672	0.4
Lumber and wood products	66,967	4.7	7,504	4.6
Furniture and fixtures	7,493	0.5	204	0.1
Pulp, paper, and related products	187,833	13.1	12,396	7.5
Sub-total	553,635	38.5	35,985	21.8
Printing and publishing	46,833	3.3	1,681	1.0
Chemicals and related products	321,761	22.4	56,137	34.1
Petroleum and coal products	207,968	14.5	58,354	35.4
Stone, clay, and glass products	69,422	4.8	5,218	3.2
Primary metal industries	84,389	5.9	742	0.5
Fabricated metal products	51,372	3.6	2,040	1.2
Machinery, except electrical	26,710	1.9	1,885	1.1
Transportation equipment	48,514	3.4	1,694	1.0
Total All Industries[a]	1,438,528	98.3	164,703	99.3

Source: Compiled from 1958 U. S. Census of Manufacturers, Department of Commerce, Advance Information, March 1960.

[a] Some figures for industry groups have been withheld from publication in order to: (1) permit further checking of figures for smaller industry groups, and (2) avoid disclosing figures for individual companies.

tensive. They account for 46.5 per cent of the employees but only 21.3 per cent of new capital. It is likely that a given amount of new capital investment will provide employment for relatively more employees in the food, lumber, and pulp industries than in the petroleum and chemical industries.

Summary

Irrespective of the measures used, the role played by food, fiber, and forestry in the state's manufacturing economy has considerable impact. Over half of the total employees in the manufacturing industries are in food, fiber, and forestry and their related products industries. Also, approximately 40 per cent of both the manufacturing payroll dollars and value added by manufacture are contributed to the Louisiana economy by this group.

Admittedly, the non-agricultural manufacturing sector has made tremendous strides in Louisiana's economy since 1939. All manufacturing output, *including the food, fiber, and forestry components,* increased 446 per cent between 1939 and 1954. The major portion of this increase is attributable to the expansion of the chemical, petroleum, and pulp industries. These advances, however, do not deny the still vital role played by agriculturally-oriented manufacturing industries.

Technological Changes in Louisiana Agriculture

Louisiana agriculture is a dynamic and progressive industry. Changes have been particularly noticeable in the most recent 10-year period. The adoption of new technology among commercial farms has been encouraging; the level of management has tended to improve and, for most products, the results in terms of yields per acre and output per man-hour have been steadily improving.[9]

Adoption of New Technology

There is ample evidence of the extent of technological changes in Louisiana agriculture—more mechanical cotton pickers, sugar cane harvesters, corn pickers, grain combines, and tractors (Table 17). The percentage of corn planted with hybrid seed increased from

TABLE 17.—Selected Machinery and Equipment, Louisiana Farms, 1950-1959

Item	Number		
	1950	1954	1959
Grain combines	3,552	4,750	5,078
Corn pickers	294	665	1,359
Pickup balers	1,957	3,122	3,991
Field forage harvesters		628	923
Motor trucks	36,824	48,644	47,160
Tractors	35,735	51,976	55,836
Cotton pickers	260	855[b]	1,122
Sugar cane harvesters	N.A.	N.A.	1,050[a]

Source: Census of Agriculture, 1945-1959, except for cotton pickers.
[a]Estimated.
[b]1955.
N.A.—Not available.

---

[9] The small scale, low income farm in Louisiana would not, of course, have advanced in proportion to advances made by the medium and large scale farms. In 1959, 71 per cent of the farms in Louisiana sold less than $2,500 of produce or were otherwise part-time, residential, or abnormal farms. The low income problem in Louisiana agriculture is a special one requiring independent analysis, which is **not** included herein. It is this group of farms, however, that lowers the average level of performance for Louisiana's farms.

less than 1 per cent in 1940 to over 61 per cent by 1957. The use of new insecticides, herbicides, and fungicides has increased greatly. These are merely a few examples of mechanical and biological changes in Louisiana's agriculture in recent years.

However, relative to the United States average, Louisiana has generally lagged behind in the adoption of technological innovations, except in the production of rice and sugar cane. The adoption of hybrid seed corn is far below the U. S. average. In 1958 approximately 64 per cent of Louisiana's total corn acreage was planted with hybrid seed, compared to 94 per cent for the U. S. average. Only the states of Montana, Wyoming, New Mexico, and Arizona had lower percentages than Louisiana. Consequently, Louisiana's corn yield per acre (28 bushels in 1958) is considerably below the U. S. average yield of 51.7 bushels. Yields on many individual farms in Louisiana are, of course, much higher than the U. S. average.

Mechanical cotton pickers are used on 55 to 60 per cent of the total cotton acreage, particularly in the Mississippi Delta and Red River Areas. As late as 1950, only 260 mechanical pickers were reported in Louisiana. The total number had climbed to 1,221 by 1960. For the period 1958-1960 there was only a slight increase in the percentage of mechanically harvested cotton. Much of this "stickiness" in the adoption of mechanical harvesters is related to the fact that, except for Areas 3 and 5, relatively small-sized cotton allotments prevail. Particularly in Areas 1A, 1B, and 6 average farm units are small and hand harvesting predominates.

The adoption of mechanical sugar cane harvesters, however, has been widespread in Louisiana. Over 96 per cent of the total acreage harvested in 1959 was harvested mechanically. Labor efficiency in cane production increased greatly during the period 1948-1959. In 1948, 8.48 man-hours were required to produce one ton of Louisiana sugar cane, compared with only 4.08 hours in 1959.

Since 1953-1954, virtually 100 per cent of Louisiana's rice production has been harvested mechanically. In 1959 over 2,000 rice combines were reported in Southwest Louisiana.

Average milk production per cow in Louisiana is well below the national average. In 1958 the average annual milk production per cow was 2,970 pounds, compared with the U. S. average of 6,330 pounds. Only Mississippi had a lower average in 1958. Part of this lag in production can be explained by the fact that sizable numbers of milk cows in Louisiana are located on relatively small scale, low income type farms. Average milk production on commercial dairy farms, however, is approximately 7,000 pounds, slightly above the national average but somewhat below the average for commercial dairies in other states.

Average egg production per layer in Louisiana was 172 eggs in 1958, considerably below the national average of 206 eggs. However, average rate of lay for commercial flocks in Louisiana was approximately 210 eggs in 1958, slightly above the United States average.

Thus while Louisiana has made great strides, the over-all average level of performance still lags behind the United States average for most measures. A large non-commercial farm sector, however, readily lowers the state average.

The Economics of Technological Change

Most new technology is adopted because of expectations of having the increased returns from technology more than offset the additional cost. The two basic types of technology—biological and mechanical—both tend to reduce per unit costs of production. If we assume market prices unchanged over a short period of time, the effect of a technological change is to increase "short run" profits to the innovator. This extra profit is usually only temporary. If time is allowed for adoption by all members of the industry, the industry volume of production will be increased, the price of the product will fall, and the extra "short run" profit will disappear. The net (long run) gain of technological change eventually goes to the consumer in the form of lower prices.

Biological changes, such as hybrid corn and resistant varieties, have the effect of increasing the volume of output (i.e., yield), assuming all other factors constant. Mechanical changes, such as corn pickers and sugar cane harvesters, are primarily of the factor-saving type, usually labor-saving. Mechanical changes usually involve a substitution of capital for labor. Mechanical changes may have the effect of increasing output indirectly. The substitution of tractor for horse and mule services displaced 148,000 animals in Louisiana between 1948 and 1958. The effect of the displacement was to increase the available cropland (formerly devoted to raising feed for these draft animals) for food and feed for meat animals. Mechanical changes also have the effect of increasing the size requirements of farms. This tends to increase total production.

The reluctance of Louisiana farmers to adopt some mechanical innovations, particularly the cotton picker, can be rationalized partly on the basis of expected returns versus the cost of making the change. Where the expected gain in returns will not offset the cost of making the change, farmers will not adopt. The rate of adoption of sugar cane harvesters has been quite pronounced, and thus it appears reasonable to assume that in this situation the expected gain in returns was greater than the cost of making the change. Whether or not to adopt a biological advance would be determined similarly. Hence, a new hybrid corn should be adopted if the additional yield will more than offset the increased cost of the new seed, harvesting, etc. Because government research funds have sponsored varietal improvement research, only part of this cost has been incorporated into the cost of the new seed paid by the farmer. Thus, the farmer benefits by having a higher yielding variety with little additional cost. Why this advantage has not been fully recognized by Louisiana farmers is not known.

It is apparent that farmers in Louisiana have not fully adopted the technology—mechanical and biological—that has already been developed by research institutions. The gap between present technological knowledge and the application of this knowledge is significant. If one distinguishes between commercial and non-commercial farms, the commercial farms of Louisiana would appear near the national average in the rate of technological adoption. These are generalizations and may not be adequately meaningful. Hence, a more detailed analysis is needed to fully account for and explain technological adoption in Louisiana agriculture.

Some Sociological Aspects of Technological Change

Sociological and other noneconomic factors are often involved in individual decisions to adopt or not adopt new technology. In a Louisiana study by Dr. Alvin L. Bertrand in 1950, the "reasons for mechanizing" were determined by interviews with farm operators.[10] Farmers regarded "economy" as the primary reason for mechanizing. The second most important reason for mechanization was labor shortage. Efficiency of the machine was the third factor in mechanization, while the fourth was the fact that machine work is easier on the operator.

Since slightly less than half of the operators interviewed by Bertrand had not adopted new types of mechanization, there is some question as to why there was a reluctance to adopt changes. Lack of necessary finances was the answer for many of those farmers who had not mechanized but wished to do so.[11] Several farmers replied that their farms were too small to successfully utilize machines. Other reasons listed for not mechanizing were age, preference for present technology, and lack of skilled labor to operate machines. Thus, economic and noneconomic factors explain farmers attitudes and actions toward mechanization.

Impact of Government Programs and Policies

Acreage Controls

Three major Louisiana crops—cotton, rice, and sugar cane—have encountered some form of acreage control in recent years. Cotton

---

[10] Alvin L. Bertrand, **Agricultural Mechanization and Social Change in Rural Louisiana**, Louisiana Agricultural Experiment Station, Bulletin No. 458, June 1951, pp. 12-15.

[11] **Ibid.**, p. 18.

TABLE 18.—Cotton Acreage Allotment, Planted Acreage, Acreage Reserve, Acreage Harvested, Louisiana, 1956-1961

Year	Acreage allotment	Acreage in Acreage Reserve (Soil Bank)	Planted acreage	Harvested acreage
	1,000 Acres			
1956	611	23	586	562
1957	610	124	461	440
1958	610	208	379	364
1959	579	0	517	490
1960	575	0	523	502
1961	646	0	595	545

and rice acreage controls are administered through legislative programs dealing with the basic commodities (cotton, rice, corn, peanuts, tobacco, and wheat), while restrictive controls for sugar cane are authorized under provisions of the Sugar Act of 1948, as amended. Restrictive proportionate shares (i.e., acreage controls) for Louisiana sugar cane have *not* been in effect since the 1958 crop year. Cotton and rice allotments have been continuously in effect in recent years.

Cotton—Cotton acreage allotments were greatly increased for the 1961 crop, following successive reductions in 1959 and 1960. Participation in the acreage reserve provisions of the Soil Bank program for the crop years 1956 through 1958 also had the effect of reducing the total acreage of cotton planted. In 1958 approximately one-third of the total Louisiana cotton allotment was set aside in the acreage reserve program (Table 18). Hence, cotton acreage planted in Louisiana in 1958 reached a new low. Upon the abandonment of the acreage reserve program in 1958, total cotton acreage planted jumped closer to the total allotment figure.

For the 1959 and 1960 crops cotton farmers receiving allotments had two price support alternatives—Plan A or Plan B. Farmers adopting Plan A received 80 per cent of parity price support on their basic cotton acreage allotment; farmers choosing Plan B could exceed the basic allotment by not more than 40 per cent and accept a 65 per cent of parity price support. These alternative plans were dropped for the 1961 crop. A large majority of Louisiana cotton farmers chose Plan A in 1959 and 1960.

It should also be noted that underplanting (i.e., planting less than the total allotment available for planting) has been considerable (62,000 acres in 1959). Part of this problem is associated with reapportionment of allotments from hill areas to the deltas.

Rice—In recent years the total rice allotment has been constant at 475,000 acres. Participation in the Acreage Reserve program

TABLE 19.—Rice Acreage Allotments, Acreage in Acreage Reserve, Planted Acreage, Harvested Acreage, Louisiana, 1956-1960

Year	Acreage allotment	Acreage in Acreage Reserve (Soil Bank)	Planted acreage	Harvested acreage
	1,000 Acres			
1956	475	8	456	450
1957	475	42	418	400
1958	475	47	414	408
1959	475	0	460	453
1960	475	0	464	458

of the Soil Bank in 1956 through 1958 reduced the total number of acres available for planting to a low of 414,000 acres in 1958. The pre-Acreage Reserve level has been resumed since 1958. There are usually between 10,000 and 15,000 available allotment acres unplanted each year in Louisiana (Table 19).

Sugar Cane for Sugar—For the Mainland Sugar Cane Area (Florida and Louisiana), acreage was restricted for the period 1954 through 1958. Acreage controls (called restrictive proportionate shares) were established for the 1959 crop but later rescinded. The effect of acreage restrictions was to reduce the allowable number of acres to which conditional government payments applied, particularly for 1956. The average number of harvested acres for the five-year period preceding acreage control was 273,000, compared with an average of 229,000 acres for the control period (Table 20).

Other Crops—Peanut allotments have been in effect in Louisiana since 1948. The state allotment for peanuts for the period

TABLE 20.—Sugar Cane Proportionate Shares, Planted Acreage, and Harvested Acreage, Louisiana, 1954-1960

Year	Total proportionate shares	Planted acreage	Harvested acreage
	1,000 Acres		
1954*	286	266	247
1955*	263	250	232
1956*	228	222	203
1957*	261	248	226
1958*	256	240	219
1959	273	273	250
1960	282	282	255

*Restrictive proportionate shares.

1948-1960 was approximately 1,900 acres each year. Less than 1,000 acres of peanuts have been planted each year on farms for which allotments have been established.

Wheat acreage allotments totalling 4,000 acres were imposed in 1957. However, each year since 1957 the Secretary of Agriculture has designated Louisiana as outside of the commercial wheat area. Consequently, no wheat allotments were in effect for the period 1958-1961.

Louisiana is not defined as a commercial corn area by the Secretary, and hence there are no corn acreage controls. Likewise, the few acres of perique tobacco grown in Louisiana are not under acreage control.

Conservation Reserve of the Soil Bank

Although the Acreage Reserve program was discontinued after 1958, the Conservation Reserve of the Soil Bank continues in effect. As of June 30, 1959, there were 2,659 Conservation Reserve contracts in Louisiana covering over 176,000 acres. Approximately 80 per cent of this acreage consisted of whole farms. The annual rental obligations for the total acreage under contract exceeded $2 million.

Government Programs to Stimulate Economic Development in Louisiana Agriculture

There are several joint state and federal action programs and/or agencies specifically oriented toward improvement of the economic status of Louisiana farmers. They include the Farm and Home Development Program, Farmers' Home Administration, the Rural Areas Development Program, and the Soil Conservation Service. Each program, however, has a different set of objectives.

Farm and Home Development—The Farm and Home Development Program, which is sponsored and promoted by the Louisiana Agricultural Extension Service, began in 1954 upon receipt of additional congressional appropriations. By 1960 there were 20 parishes with agents working primarily in Farm and Home Development work. Approximately 1,400 farm families were enrolled in the program in 1960. The major objective of the program is to assist farmers in decision-making or planning the "whole" farm program. Both farm resources and family goals are considered in developing farm plans. This program is concerned primarily with commercial, family-sized farms.

The results of the program have been encouraging in terms of increasing net farm income for farmers enrolled in the programs. Results are unavailable for all participating parishes in Louisiana, but on the basis of a sample of 143 Farm and Home Development farms in Washington, Franklin, Caddo, Iberia, and East Carroll parishes, average net farm income increased from $2,791 per farm in 1954 to $5,375 in 1958, or 92 per cent.

The Farm and Home Development approach has been so successful that the philosophy of Extension work is changing, not only within Louisiana but nationwide, to recognize the importance of planning the "whole" farm program.

Farmers' Home Administration and Soil Conservation Service—Both the Farmers' Home Administration and the Soil Conservation Service are also concerned with farm planning to raise net income.

The Farmers' Home Administration is a governmental agency set up for the purpose of lending money to farmers (and recently part-time farmers) unable to procure financial assistance from other private or governmental lending institutions. In the making of farm loans, farm planning has been a useful tool for the past few decades.

The Soil Conservation Service uses farm planning in connection with soil improvement practices.

Both programs have met with a considerable degree of success in Louisiana.

Rural Development Program—The Rural Development Program was inaugurated in 1955 for the purpose of stimulating economic development in low production farm areas. The national committee included Under Secretaries from the Departments of Agriculture, Interior, Commerce, Labor and Health, Education and Welfare, plus the Administrator of the Small Business Administration and a member of the President's Council of Economic Advisors. In 1961 the Rural Development Program was superseded by the Rural Areas Development Program and enlarged in scope.

Louisiana's Rural Development Program was initiated in 1956. Three parishes—Avoyelles, Franklin, and Washington—were established as pilot or demonstration parishes early in 1957. Some of the activities in these parishes included expansion of agricultural production and rural industries. Since hundreds of farm people are seeking part-time work in all three parishes, rural industry development is a priority objective. The Louisiana Agricultural Extension Service furnished personnel for the program. Assistance was also provided by such agencies as the Soil Conservation Service, Farmers' Home Administration, the Louisiana Division of Employment Security, other public agencies, and private groups.

In terms of its impact on the low income problem in Louisiana, the effect of the program was negligible, owing principally to the program's small scale. However, a limited degree of tangible progress was evidenced in the three pilot parishes, despite meager inputs into the program. Projects partially or wholly attributed to the Rural Development Program in Franklin Parish included the construction of a grain elevator, a sweet potato storage shed, plus enlargement to an existing garment factory. In Avoyelles Parish, for example, a sweet potato auction in Marksville was established; a new woodworking mill was erected; and sewage and water systems were developed for several small towns. In each of the three parishes physical resources were evaluated. More significantly, local citizens and agencies became aware of joint economic and social problems and organized into a body for action.

Rural Areas Development Program—In 1961 the Secretary of Agriculture put into action a revitalized rural development program designed to eliminate rural poverty and underdevelopment by directing a large segment of the resources and activities of the Department of Agriculture to assist with rural development problems. Local initiative and leadership, however, is necessary for the program's success.

The Cooperative Extension Service was charged by the Secretary of Agriculture with the responsibility of encouraging local leaders in agriculture, industry, and trade to study their economic and social problems, review the possibilities, and organize for the needed area action. Local rural areas development committees are assisted by various other U.S.D.A. agencies, such as the Farmers' Home Administration, Rural Electrification Administration, and the Soil Conservation Service.

Representative citizens of any parish of Louisiana may organize Rural Areas Development Committees for the purpose of promoting economic growth and development. Organized committees receive the technical advice and support of the Louisiana Extension Service, Farmers' Home Administration, and the other interested governmental agencies.

Area Redevelopment Program—Congress enacted the Area Redevelopment Act in 1961 to combat unemployment, underemployment, and chronic poverty in urban and rural areas. Although the United States Department of Commerce is legislatively designated as the agency in charge of the Area Redevelopment Program, the Department of Agriculture has been given the responsibility for helping eligible rural counties obtain benefits under the Act. Only officially designated counties are eligible to receive the financial loans and grants made available under the Act. Twenty parishes of Louisiana have been designated by the Commerce Department as eligible for assistance as of January, 1962. They are as follows: Acadia, Allen, Ascension, Avoyelles, East Carroll, East Feliciana, Evangeline, Franklin, Lafayette, Madison, Natchitoches, Red River, Sabine, St. Landry, Tangipahoa, Tensas, Vermilion, Vernon, Washington, and West Carroll.

The Louisiana Department of Commerce and Industry was assigned the major responsibility for the over-all program, although various state and federal agricultural agencies, particularly the Louisiana Agricultural Extension Service and the Farmers' Home Administration, also play key roles.

In the eligible parishes loans are available for land, buildings, machinery and equipment, but not for working capital. Loans are also available for new public facilities that will promote new permanent employment. Approved over-all economic development plans, prepared by representative groups within eligible parishes, are required before loans become available. Over-all economic development plans are not required for technical assistance funds, however.

Summary and Conclusions

The recent historical trend in Louisiana agriculture is encouraging in terms of resource adjustment. Area specialization is developing in line with physical and economic factors. Areas of relatively infertile soils are reverting to forest or other use, while areas of reasonably fertile soils are becoming the major contributors of agricultural output. Also, areas having climate and/or soil characteristics necessary for particular crops—rice, sugar cane, oranges—continue to specialize in those products.

The level of performance in terms of yields and adoption of mechanical and biological innovations has greatly improved. Particularly noticeable have been yield increases for cotton, sweet potatoes, soybeans, and sugar cane during the past 30 years. Mechanical harvesting methods are almost universal for rice and sugar cane, while mechanical cotton pickers harvest approximately 60 per cent of the total cotton acreage.

Within the past few decades the cattle industry has greatly increased in relative importance. In 1957 and 1958, cattle and calves accounted for the largest portion of Louisiana's total cash farm income, replacing the perennial leader—cotton. Also, commercial broiler, milk, soybean, and wheat production has increased significantly in recent years.

Some agricultural commodities, however, have performed poorly in terms of yield and production. There is little evidence of increases in strawberry, oat, and commercial vegetable yields over time. Total production of peaches, oranges, sheep, hogs and pigs, strawberries, Irish potatoes, commercial vegetables, and sugar cane for syrup has generally declined over the past 30 years. Tung nut production has generally declined in the past 10 years.

These changes in product composition, production, and performance of Louisiana agriculture are the result of numerous interrelated physical and economic factors. How these factors are related and why these results have been achieved is a complicated economic problem. The important point here is that *dramatic changes have occurred in Louisiana's agriculture during the past 30 years.*

Various lags in adjustment and performance in Louisiana agriculture must be recognized. Some of these problems may be summarized as follows:

(1) The solution to the low income, low production, farm problem is vexing and to date remains unsolved.[12] Approximately 70 per cent of Louisiana farms in 1959 earned less than $2,500.

(2) Large numbers of low income farms have been slow in adoption of mechanical and biological innovations. Consequently, some levels of performance in Louisiana agriculture have been low relative to the national average.

(3) Even among commercial-sized units, there has been a lag between technological knowledge and actual farm practices.

(4) Average managerial ability is still quite low. Educational attainment of the rural farm population 25 years of age or over, although improving over time, could stand further improvement. In 1950, 80 per cent of the rural-farm population over 25 years of age had not attended high school.

(5) The amount of individual farm planning is still at a relatively low level. On the basis of results of the Farm and Home Development Program in Louisiana, much could be done to improve net income on many Louisiana farms by systematic reorganization and careful planning.

Although serious lags and imperfections exist in the Louisiana farm sector, considerable adjustment has occurred in recent years. This is some indication that the future will provide a more effective utilization of Louisiana's abundant and diverse agricultural resources.

---

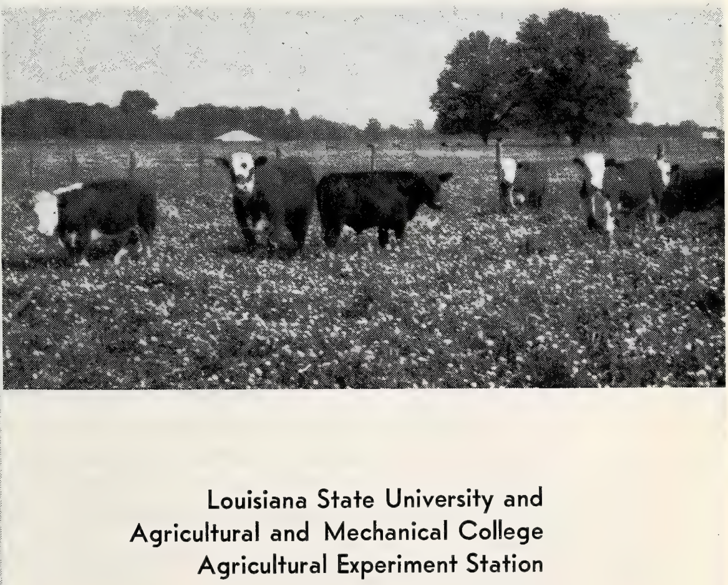
[12] For an excellent study of the low income problem in Louisiana agriculture, see Bill Bolton, **Resource Use and Adjustment Potential: Rural Families in the Central Louisiana Mixed Farming Area**, Louisiana Agricultural Experiment Station, Bulletin No. 545, June 1961.

Bulletin No. 551

January 1962

Diethylstilbestrol Studies With Beef Cattle

C. W. NEWMAN
J. Y. OAKES
W. A. NIPPER



Louisiana State University and
Agricultural and Mechanical College
Agricultural Experiment Station
Charles W. Upp, Director

Table of Contents

Introduction 3

Review of Literature 3

Experimental Trials 4

  Studies with Nursing Calves 4

  Studies with Feedlot Cattle 7

  Grazing Studies 9

Summary 11

Conclusions and Recommendations 11

Literature Cited 12

Acknowledgments

The authors wish to express their thanks to the Shreveport Packing Company and Clark Commission Company for their cooperation in obtaining weights and grades. The oral diethylstilbestrol was supplied by Eli Lilly and Company and the diethylstilbestrol implants were furnished by Chas. Pfizer and Company, Inc. The Feed Service Corporation, Crete, Nebraska, supplied the urea-molasses mixture for the 1957-1958 feedlot trials.

Diethylstilbestrol Studies With Beef Cattle

C. W. Newman, J. Y. Oakes and W. A. Nipper*
Red River Valley Agricultural Experiment Station

Introduction

Diethylstilbestrol, commonly called stilbestrol or DES, is a commercially produced synthetic chemical compound which exhibits characteristics similar to certain natural hormones. Recently, it has received attention as a growth stimulant in ruminants.

The data in this report are the results of four years of beef cattle research at the Louisiana Red River Valley Agricultural Experiment Station using DES in drylot feeding, grazing, and on suckling calves. Experimental work with cattle at other stations has been concerned mainly with drylot feeding and grazing. Less information has been reported on the response of growing or nursing calves to stilbestrol than on feeder cattle. Since the production of slaughter calves is vitally important to the cattle industry, it was believed that response investigations in a cow-and-calf program would be useful.

Stilbestrol can be given to livestock either orally in the feed or by subcutaneous implants made near the apex of the ear. Neither method is considered superior to the other, although each has certain advantages. The oral method requires no handling of the cattle since it may be purchased premixed in the protein supplement. The implant procedure requires that the animals be restrained for treatment. Cattle being grazed without supplemental feed, however, can be treated with the implant. Less stilbestrol is needed with the implant than in a feed supplement.

Review of Literature

Data have been published showing the benefits of stilbestrol for fattening steers and heifers. Burroughs *et al.* (2) showed that stilbestrol administered orally increased live weight gains and reduced the feed required per unit of gain. Burroughs *et al.* (3) also reported a 20 percent increase in rate of gain and an 11 percent decrease in pounds of feed per pound of gain when steers were fed five and ten milligrams per head daily. Faster gains and greater feed efficiency in implanted drylot fed steers were reported by Clegg *et al.* (4), Baird and Sell (1), O'Mary *et al.* (7), and O'Mary *et al.* (8). O'Mary and Cullison (6) reported that implants in steers grazing winter pastures significantly increased daily gains over the control steers grazing the same pastures.

The work of Nelson *et al.* (5) showed that twelve milligram implants of stilbestrol increased gains on an average of twenty-two pounds in eight trials with suckling steer calves and an average of thirty-six pounds in five trials with suckling heifer calves. These authors observed noticeable side effects in a few of the treated animals.

---

*Present address—LSU Alexandria, Alexandria, Louisiana.

Experimental Trials

Studies with Nursing Calves

The results of three years' work with grade Hereford nursing calves are presented.

Procedure—The calves were divided equally into two groups in each trial on the basis of weight, age, sex, and uniformity of their dams. Calf weights were taken at the beginning of each trial and at the end of each twenty-eight day period thereafter until weaning, at which time they were graded according to U.S.D.A. slaughter calf standards and appraised at the prevailing market price by a professional cattle buyer.

The fall calf studies were conducted jointly with the creep feeding investigations on spring pastures. In 1957, twenty-four fall calves were equally divided into two groups and one group was creep-fed and the other served as a control. One-half of the steers and heifers in each group were implanted with twelve milligrams of stilbestrol. The twelve milligram level was selected as the initial level because twenty-four and thirty-six milligram dosages were recommended for heavier calves on pasture or in the feedlot. Excellent pastures of fescue, rye grass and wheat were grazed during the trial period. This procedure was again repeated in 1958 and 1959 with the exception that twenty calves were used in the latter two years, and grazing was limited to wheat in 1959.

The spring calf studies were initiated in 1957 with two lots of six steer calves each. The steers in one lot were implanted with twenty-four milligrams of stilbestrol. The dosage was increased to determine the effects of the higher level on gains and appearance of calves at this weight and age. Both lots were grazed for one hundred eleven days with their dams on a Coastal Bermuda grass pasture. This procedure was followed in 1958 and 1959 with the exception that the implants were reduced from twenty-four milligrams to twelve milligrams due to excessive side effects in the 1957 trials. There were fourteen heifer calves and twelve steer calves in the 1958 study, and the heifers and their dams were grazed at a separate location from the steers and their dams. In 1959 ten heifers and ten steers were included in the study and grazed together on the same pasture.

Results and Discussion—In the 1957 study, implanted fall calves on creep averaged thirty-three pounds heavier and returned $7.34 more per calf at weaning than non-implanted creep-fed calves. The non-creep implanted calves averaged twenty-six pounds more per calf and returned $5.66 per calf more than control calves in this group. The treated and non-treated calves in both the creep-fed and the non-creep-fed group sold for approximately the same price per hundredweight. In the spring calf studies, implanted calves gained an average of forty-six pounds more than the control group. Some characteristic side effects, such as high tail heads and elongated teats, were noted in treated calves during the spring trial.

The results of the 1958 and 1959 fall calf studies are shown in Tables 1 and 2. Average daily gains were not significantly different between the creep-fed and the non-creep-fed groups. The implanted calves gained faster in each trial. There were no appreciable differences between treatments in regard to grades or the appraised value per hundredweight at weaning. The gains of the treated steer calves were significantly faster than the controls in both years. Implanted heifer calves in the

TABLE 1.—Response of Fall Dropped Nursing Calves with and without Creep Feed to 12 Mg. Stilbestrol Implants, 1958

	Creep-Fed		Non-Creep-Fed	
	12 Mg. Implants	Control	12 Mg. Implants	Control
Number of calves	5	5	5	5
Av. initial age, days	130	122	126	129
Av. initial weight, lbs.	252	244	243	260
Av. final weight, lbs.	494	449	474	461
Av. total gain, lbs.	242	205	231	201
Av. daily gain, lbs.	2.42	2.05	2.31	2.01
Weaning grades:				
Choice	0	0	2	1
Good	2	2	1	2
Standard	3	2	2	1
Utility	0	1	0	1
Average weaning grade(a)	2.40	2.20	3.00	2.60
Appraised value per cwt.	$25.13	$25.11	$25.90	$25.16

(a)4 = Choice; 3 = Good; 2 = Standard; 1 = Utility at the end of 100-day trial (Feb.-June).

TABLE 2.—Response of Fall Dropped Nursing Calves with and without Creep Feed to 12 Mg. Stilbestrol Implants, 1959

	Creep-Fed		Non-Creep-Fed	
	12 Mg. Implants	Control	12 Mg. Implants	Control
Number of calves	5	5	5	5
Av. initial age, days	140	147	132	135
Av. initial weight, lbs.	272	271	270	267
Av. final weight, lbs.	517	500	503	471
Av. total gain, lbs.	245	229	233	204
Av. daily gain, lbs.	2.72	2.55	2.59	2.26
Weaning grades:				
Choice	4	3	4	3
Good	1	1	1	0
Standard	0	1	0	2
Utility	0	0	0	0
Average weaning grade(a)	3.30	3.10	3.50	2.90
Appraised value per cwt.	$32.69	$31.68	$31.59	$31.50

(a)4 = Choice; 3 = Good; 2 = Standard; 1 = Utility at the end of 90-day trial (Mar.-June)

TABLE 3.—The Effects of Stilbestrol Implants Upon Steer and Heifer Spring Dropped Nursing Calves, 1958

	Steers		Heifers	
	12 Mg. Implants	Control	12 Mg. Implants	Control
Number of calves	6	6	7	7
Av. initial age, days	88	82	82	86
Av. initial weight, lbs.	232	234	231	233
Av. final weight, lbs.	443	443	444	444
Av. total gain, lbs.	211	209	213	211
Av. daily gain, lbs.	1.50	1.48	1.51	1.50
Weaning grades:				
Choice	0	0	1	2
Good	0	0	6	3
Standard	3	2	0	2
Utility	3	4	0	0
Average weaning grade(a)	1.50	1.33	3.14	3.00
Appraised value per cwt.	$22.76	$22.80	$26.21	$25.68

(a)4 = Choice; 3 = Good; 2 = Standard; 1 = Utility at the end of 141-day trial (May-Oct.).

TABLE 4.—The Effects of Stilbestrol Implants Upon Steer and Heifer Spring Dropped Nursing Calves, 1959

	Steers		Heifers	
	12 Mg. Implants	Control	12 Mg. Implants	Control
Number of calves	5	5	5	5
Av. initial age, days	139	142	133	129
Av. initial weight, lbs.	270	268	249	251
Av. final weight. lbs.	486	438	443	436
Av. total gain, lbs.	216	170	194	185
Av. daily gain, lbs.	1.80	1.42	1.62	1.54
Weaning grades:				
Choice	1	2	2	3
Good	4	2	0	1
Standard	0	1	3	1
Average weaning grade(a)	3.10	3.00	2.70	3.40
Appraised value per cwt.	$29.09	$28.77	$27.06	$27.76

(a)4 = Choice; 3 = Good; 2 = Standard; 1 = Utility at end of the 120-day trial (June-Oct.).

non-creep-fed group gained significantly faster than the control heifers in the 1959 trial, but not in the 1958 trial. The data from these two trials with fall calves show that implanted steer calves gained an average of 37.7 pounds more than control steer calves, while implanted heifer calves gained an average of 13.5 pounds more than the control heifer calves.

Tables 3 and 4 show the results of the 1958 and 1959 trials with non-creep-fed spring calves. In 1958, average daily gains of the implanted and non-implanted steers and heifers were not significantly different. Average daily gains of the implanted steers in the 1959 study were significantly higher than the average daily gains made by the non-implanted steers. The implanted heifer calves gained faster than the non-implanted heifers in 1959, but not significantly. There were no significant differences in grades and appraised value per hundredweight of the calves within each year.

A considerable difference was observed in the growth response of steer and heifer calves to stilbestrol in all but one of the trials conducted with nursing calves in 1958 and 1959. Gains of implanted steer calves were significantly higher than control steers in all trials except the 1958 study with spring calves. The only instance where implanted heifers gained significantly more than control heifers was in the group which was not creep-fed during the 1959 fall study. In the four trials with fall and spring calves, conducted during 1958 and 1959, implanted steer calves gained an average of thirty-three pounds more than control steer calves, while implanted heifer calves gained an average of eleven pounds more than control heifer calves.

Studies with Feedlot Cattle

Stilbestrol studies with feedlot cattle at this station were initiated in 1956 and continued through 1958. Yearling steers and heifers obtained from the station herd of grade Hereford cattle composed the majority of the animals used in these trials. Similar cattle purchased from nearby farms supplied the remainder of the experimental animals.

Procedure—The cattle were divided into equal groups on the basis of sex, weight and feeder grade. The cattle were weighed at the beginning of each trial and at the end of each twenty-eight day period thereafter until the trial was completed. Final weights were taken at the feedlot and market weights were obtained from the packer. The cattle were appraised and returns were calculated from market weight and the average price per lot. Slaughter grades, carcass grades, and carcass weights were furnished by the packer.

In 1956, two groups of steers and heifers were full-fed a ration of ground ear corn, crimped oats, cottonseed meal and molasses plus hay and minerals fed free-choice. Stilbestrol was incorporated in the ration of Lot 1 to give each animal an average of ten milligrans daily. In 1957, Lots 1, 2 and 3 received the same ration as was fed in 1956. Lots 4 and 5 were fed hay free-choice plus a concentrate mixture of ground ear corn and crimped oats, limited to approximately one pound per hundred pounds of body weight. A 30 percent protein equivalent urea-molasses mixture was supplied free-choice to these two lots in place of cottonseed meal. Sufficient feed containing stilbestrol was fed to the calves in Lot 1 to give each animal an average of ten milligrams per head daily. The calves in Lots 2 and 4 were implanted with sixty milligrams of stilbestrol.

In 1958, Lots 1, 2 and 3 were full-fed a ration of ground ear corn, cottonseed meal and molasses with hay and minerals fed free-choice. The ration fed animals in Lots 4 and 5 was the same as above except that cottonseed meal was replaced by a 30 percent protein equivalent urea-molasses mixture and fed free-choice. Animals in Lot 1 were fed sufficient feed containing stilbestrol to give each animal an average of ten milligrams daily. Calves in Lots 2 and 4 were implanted with thirty-six milligrams of stilbestrol. The implant level was reduced from sixty milligrams to thirty-six milligrams because excessive side effects appeared in animals implanted with the larger dosage the previous year.

Results and Discussion—The results of the 1956, 1957 and 1958 feedlot trials are shown in Table 5, 6 and 7, respectively. Gains were increased in all lots when stilbestrol was either included in the ration or implanted in the animals. The implanted calves on full rations of corn and cottonseed meal in the 1957 and 1958 trials gained an average of 16.3 percent more than the control calves. An average of the 1956, 1957 and 1958 trials with oral stilbestrol showed that calves on treated feed gained an average of 9.9 percent more than control calves. Average increase in feed efficiency of the implanted calves, based on two years' data, and of the orally treated calves, based on three years' data, was 11.4 and 6.8 percent, respectively. Gains of the implanted cattle in the group fed the urea-molasses mixture in the 1957 trials were 42.7 percent more than the controls. However, only a small difference was found between the treated and control cattle in this group in the 1958 trial.

There were no significant differences in shrinkage, dressing percent and carcass grades between treated and untreated lots. Some variations in selling prices were noted. Cattle fed stilbestrol sold for $0.27 more to $1.00 less per hundredweight than controls. The implanted calves sold for $1.00 more to $0.75 less per hundredweight than the untreated animals. The increased gain credited to stilbestrol increased net returns

TABLE 5.—Response to Stilbestrol of Yearling Steers and Heifers Receiving a Fattening Ration, 1955-56

	Lot 1[a]	Lot 2
	Oral Stilbestrol	Control
Number of days	100	100
Number of animals	15	15
Av. initial weight, lbs.	514	509
Av. final weight, lbs.	782	747
Av. total gain, lbs.	268	238
Av. daily gain, lbs.	2.68	2.38
Percent increase in gain	12.60	
Slaughter grades:		
Choice	7	7
Good	8	8
Dressing percent	59.66	58.85
Av. daily feed, lbs.	18.68	18.16
Feed per 100 lbs. gain	697	763
Av. percent increase in feed efficiency	8.65	
Selling price per cwt.	$16.47	$16.20

[a] Animals received 10 mg. stilbestrol orally per day in total feed consumed.

TABLE 6.—Results of Oral and Implant Stilbestrol Treatments of Steers and Heifers Fed Cottonseed Meal and of Implant Treatment of Steers and Heifers Fed Urea-Molasses as Protein Source, 1956-57(a)

Lot No. Treatment Protein Supplement	1 Oral CSM	2 Implanted CSM	3 Control CSM	4 Implanted Urea-Molasses	5 Control Urea-Molasses
Number of days	113	113	113	113	113
Number of animals	8	8	8	6	8
Av. initial weight. lbs.	536	551	549	525	540
Av. final weight, lbs.	806	831	794	789	725
Av. total gain, lbs.	270	280	245	264	185
Av. daily gain, lbs.	2.39	2.48	2.16	2.34	1.64
Percent increase in gain	10.20	14.28		42.70	
Av. market weight, lbs.	757	775	751	735	679
Av. shrink, lbs.	49	56	43	54	46
Av. shrink, percent	6.08	6.74	5.41	6.84	6.34
Av. carcass weight, lbs.	452	464	444	430	391
Av. dressing percent	59.71	59.87	59.12	58.50	57.58
Carcass grades:					
Choice	6	6	4	1	1
Good	2	2	4	5	7
Standard	0	0	0	0	0
Feed consumed daily, lbs:					
Concentrates	17.11	17.15	16.28	6.42	6.30
Hay	4.75	4.66	4.29	10.89	10.31
Urea-molasses				3.15	3.06
Av. daily feed, lbs.	21.86	21.81	20.57	20.46	19.67
Av. feed/100# gain, lbs.	915	880	949	876	1,202
Av. percent increase in feed efficiency	3.58	7.27		27.12	
Av. initial cost/cwt.	$13.28	$13.52	$14.95	$13.81	$13.22
Av. feed cost	$50.60	$50.51	$47.63	$47.63	$47.51
Av. selling price/cwt.	$18.25	$18.25	$19.00	$17.00	$17.25

(a) Animals other than controls received 60 mg. implants or 10 mg. stilbestrol per day in total feed consumed.

in all treated lots except the oral fed stilbestrol lot in the 1958 trial. The difference in this instance was due to a $1.00 per hundredweight difference in selling price in favor of the control group.

Grazing Studies

Stilbestrol research was conducted jointly in a study designed to determine if feeding a limited grain ration to yearling Hereford steers and heifers grazing on wheat pasture was economical.

Procedure—In each experiment, yearling steers and heifers were divided into two groups according to weight, sex and feeder grade. One group was grazed on wheat pasture and the other received a limited ration of ground ear corn and cottonseed meal in addition to wheat pasture. In 1957, ten animals in each group were implanted with forty-eight milligrams of stilbestrol, and in 1958 one-half of the animals in each

TABLE 7.—Results of Oral and Implant Stilbestrol Treatments of Steers and Heifers Fed Cottonseed Meal and of Implant Treatment of Steers and Heifers Fed Urea-Molasses as Protein Source, 1957-58[(a)]

Lot No.	1	2	3	4	5
Treatment	Oral	Implanted	Control	Implanted	Control
Protein Supplement	CSM	CSM	CSM	Urea-Molasses	Urea-Molasses
Number of days	116	116	116	116	116
Number of animals	10	10	10	10	10
Av. initial weight, lbs.	539	539	557	543	546
Av. final weight, lbs.	801	829	802	802	794
Av. total gain, lbs.	262	290	245	259	248
Av. daily gain, lbs.	2.26	2.50	2.11	2.23	2.14
Percent increase in gain	6.94	18.37		4.44	
Av. market weight, lbs.	771	787	775	766	763
Av. shrink, lbs.	30	42	27	36	31
Av. shrink, percent	3.74	5.07	3.37	4.49	3.90
Av. carcass weight, lbs.	462	471	463	464	453
Av. dressing percent	59.92	59.85	59.74	60.57	59.37
Carcass grades:					
Choice	2	1	0	1	1
Good	8	8	10	7	9
Standard	0	1	0	2	0
Av. carcass grade	3.6	2.8	3.4	2.9	3.3
Feed consumed daily, lbs.					
Ground earn corn	13.29	13.55	13.47	15.44	14.81
Cottonseed meal	2.21	2.26	2.24		
Urea-molasses				1.92	1.88
Molasses	1.62	1.66	1.65	1.89	1.86
Alfalfa hay	2.12	2.25	2.36	1.92	1.91
Grass hay	4.02	4.22	4.04	4.02	3.49
Av. feed daily, lbs.	23.26	23.94	23.76	25.19	23.95
Av. feed/100# gain, lbs.	1,030	958	1,125	1,128	1,120
Av. percent increase in feed efficiency	8.44	14.84			
Av. initial cost/cwt.	$19.16	$19.19	$18.95	$19.22	$18.95
Av. feed cost	$54.07	$54.20	$53.86	$59.05	$56.50
Av. selling price/cwt.	$23.50	$24.50	$24.50	$25.00	$24.00

[(a)] Animals other than controls received 36 mg. implants or 10 mg. stilbestrol per day in total feed consumed.

group were implanted with twenty-four milligrams of stilbestrol. Weights were taken as previously described under feedlot studies.

Results and Discussion—Table 8 shows the resulting increase in gains from the stilbestrol implants. There was no appreciable difference in slaughter grades or the appraised value per hundredweight of the treated and control calves. Some undesirable side effects, such as high tail heads, elongated teats, and enlarged mammary glands were noted in the 1957 study. The twenty-four milligram implant in the 1958 trial stimulated gains equally as well as the forty-eight milligram implants with fewer noticeable side effects. The calves fed the grain ration on

TABLE 8.—Response of Steers and Heifers to Stilbestrol Implants Grazing on Wheat Pastures Supplemented and Unsupplemented

	Grain Supplement		Grazing Alone	
	Implanted	Control	Implanted	Control
*Number of animals (48 mg.)	10	10	10	10
Av. daily gain, lbs.	2.46	1.88	2.17	1.68
**Number of animals (24 mg.)	12	13	7	8
Av. daily gain, lbs.	2.24	1.94	2.65	2.51

*February 4 to May 15, 1957, or 100 days.
**February 25 to May 7, 1958, or 72 days.

pasture evidenced more response to the stilbestrol than did those maintained on pasture alone.

Summary

Results of experiments conducted with nursing calves in 1957, 1958 and 1959 show that calves implanted with twelve milligrams of stilbestrol gained faster than controls. Steer calves evidenced more growth response to stilbestrol implants than did heifer calves. There were no consistent differences in calf grades or appraised value in any trial. No undesirable side effects were observed when implants were limited to twelve milligrams. In feedlot trials, a 9.9 percent increase in average gains was observed when stilbestrol was fed and 16.3 percent when implanted. Feed efficiency was increased in orally treated animals by 6.8 percent, and in those implanted by 11.4 percent. No appreciable differences were observed in shrinkage from feedlot to market, dressing percent or carcass grades between the treated and control animals. Yearling steers and heifers implanted while grazing winter wheat pastures gained 16.1 percent faster than similar cattle not implanted. There was some evidence of side effects in the implanted cattle during each year's grazing study and these effects were more pronounced in animals receiving more than twenty-four milligrams.

Conclusions and Recommendations

In view of the data presented, the following conclusions and recommendations are made:

1. Stilbestrol implants in nursing calves at three to four months of age resulted in heavier weaning weights. Undesirable side effects at high levels made twelve milligram implants more desirable than twenty-four milligrams. Treated steer calves made a more consistent increase in gains than heifer calves, and value per hundredweight of calves at weaning was not lowered when twelve milligrams of stilbestrol was not exceeded.

2. Stilbestrol, whether fed or implanted, increased gains and feed efficiency of cattle under feedlot conditions. Implants of 36 milligrams in-

creased gains as much as did 60 milligrams with fewer animals showing incidence of side effects. Neither shrinkage, dressing percent, carcass grade nor selling price of yearling cattle was adversely affected by stilbestrol in this study.

3. Gains of yearling cattle, grazing green lush pastures were increased by stilbestrol implants. Best results were obtained from 24 milligram implants.

4. These results emphasize that caution must be exercised in the use of stilbestrol. Implants in nursing calves should be limited to one twelve-milligram implant. Calves to be implanted should be at least ninety days old or weigh two hundred pounds. Data indicate at this time that only steer calves of this age and weight should be implanted. Feedlot cattle should not receive more than thirty-six milligrams as an implant or more than ten milligrams daily when included in the feed. Implants in grazing cattle should be limited to twenty-four milligrams.

Literature Cited

1. Baird, D. M., and O. E. Sell. 1957. Oral and implanted stilbestrol for growing-fattening beef cattle on winter pastures and in dry-lot. Ga. Expt. Sta. Mimeo. Series N. S. 32.
2. Burroughs, Wise, C. C. Culbertson, Edmund Chung, W. H. Hale and Joseph Kastelic. 1954. Oral administration of diethylstilbestrol for growth and fattening in beef cattle. J. Animal Sci. 13:978. (Abstract).
3. Burrough, Wise, C. C. Culbertson, Edmund Chung, W. H. Hale and Paul Hormeyer. 1955. The influence of oral administration of diethylstilbestrol to beef cattle. J. Animal Sci. 14:1015.
4. Clegg, M. L., and H. H. Cole. 1954. The action of stilbestrol on the growth response in ruminants. J. Animal Sci. 13:108.
5. Nelson, A. B., L. S. Pope, E. J. Turman and R. Totusek. 1959. Stilbestrol and an antibiotic (erythromycin) for suckling beef calves. Feeding and Breeding Test Progress Report, 1958-59, Okla. Expt. Sta.
6. O'Mary, C. C., and A. E. Cullison. 1956. Effects of low level implantation of stilbestrol in steers on pasture. J. Animal Sci. 15:48.
7. O'Mary, C. C., E. P. Warren, T. J. Davis and H. H. Pierce, Jr. 1956. Effects of low level implantation of stilbestrol on steers fattened on dry-lot rations. J. Animal Sci. 15:52.
8. O'Mary, C. C., A. E. Cullison, J. L. Carmon. 1959. Implanted and oral stilbestrol for fattening steers. J. Animal Sci. 18:14.

MIDDLETON LIBRARY
DATE DUE

~~FE[illegible]~~

~~NOV 14 1982~~

~~SEP 03 1984~~

NOV 06 1984

NOV 17 1984

mb NOV 26 1984

~~[illegible] 29 19[illegible]~~ TC

LOUISIANA STATE UNIVERSITY

LSU Libraries
3 1518 097 539 823

S
67
E36
no.523-551

La. Agricultural Experiment
Station. Bulletin.

LOUISIANA STATE UNIVERSITY
TROY H. MIDDLETON LIBRARY
BATON ROUGE

Do not remove slip from pocket. In the event the book is returned without this slip, a penalty of $1.00 will be charged.

BOUND BY
HM